



ARIZONA HIGHWAY DEPARTMENT

ROADWAY CONSTRUCTION

STANDARDS

1968

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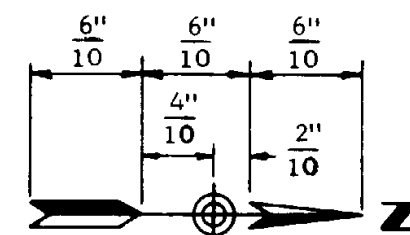
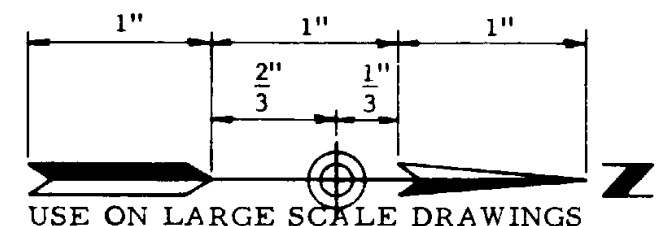
GENERAL NOTE: The term Plans, as used herein, shall refer to the Roadway Construction Plans.

STATE OR NATIONAL LINE	-----
COUNTY LINE	-----
TOWNSHIP OR RANGE LINE	-----
SECTION LINE	-----
QUARTER SECTION LINE	-----
FOREST OR RESERVATION LINE	----- Shading on inside of line
HIGHWAY R/W LINE	-----
CONTROL OF ACCESS LINE	----- BLU ZIP NO. 333 & CHART PAK 256 TAA 1" WIDE Shading on outside of line
UNFENCED PROPERTY	----- Blu-Zip No. 113
CITY LIMITS	-----
SECTION AND QUARTER CORNERS	----- Depressed for driveway
COMBINED CURB & GUTTER	----- New Existing
SIDE ROAD TURNOUT	----- (1)-(2) ----- New Existing
GROUND LINE	-----
EXISTING ROAD	----- (2) ----- Width & type Blu-Zip No. 438
OBLITERATE PAVEMENT	----- (2) ----- Blu-Zip No. 340
NEW CONCRETE PAVEMENT	----- (1) ----- Blu-Zip No. 309
NEW BIT. MIX. PAVEMENT	----- (1) ----- Blu-Zip No. 310
EXISTING PAVEMENT	----- (2) -----
BIT. PAVEMENT (SECTION)	-----
P.C. CONCRETE (SECTION)	-----
AGGREGATE BASE	-----
SELECT MATERIAL	-----
SUB GRADE SEAL	-----

TREES AND SHRUBS	-----
TRAFFIC SIGN	-----
ADVERTISING SIGN	----- Large Small New Existing
GUARD RAIL	-----
BARRIER POST - HAZARD MARKER	-----
STANDARD BARBED WIRE FENCE	----- Gate
WOOD FENCE	-----
FABRIC WIRE FENCE	-----
CATTLE GUARD	----- (1)-(2) ----- New Existing
CHANNEL OR DITCH	-----
DYKE OR LEVEE	-----
BANK PROTECTION	-----
RETAINING WALL	-----
PIPE CULVERTS	----- (1)-(2) ----- New Existing
REINF. CONC. BOX CULV	----- (1)-(2) ----- New Existing
C.M.P. DOWNDRAIN	----- 1-Way 2-Way
CONCRETE SPILLWAY	----- 1-Way 2-Way
DROP INLET OR CATCH BASIN	-----
MANHOLE	----- New Exist. To be Adjusted
FIRE HYDRANT	----- New Exist.
VALVE (WATER OR GAS)	----- W G
METER BOX	-----
TELEPHONE BOOTH	-----
STREET LIGHT	----- On. Ext. Arm
DOWN GUY AND ANCHOR	-----
TELEPHONE OR TELEGRAPH LINE	-----
POWER LINE OR JOINT LINE	-----
WATER LINE	----- W ----- 2"
GAS LINE	----- G ----- 3"
IRRIGATION LINE	----- IRR ----- 12"
STORM SEWER	----- SS ----- 30"
SANITARY SEWER	----- S ----- 8"

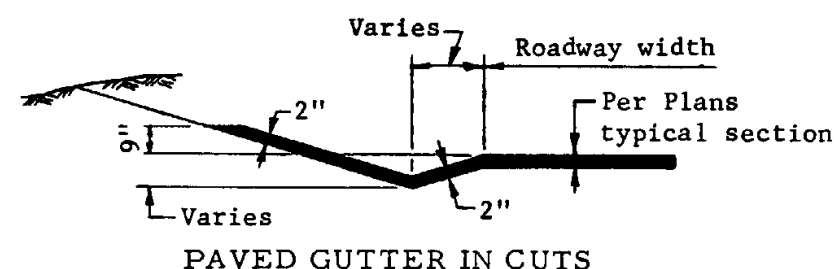
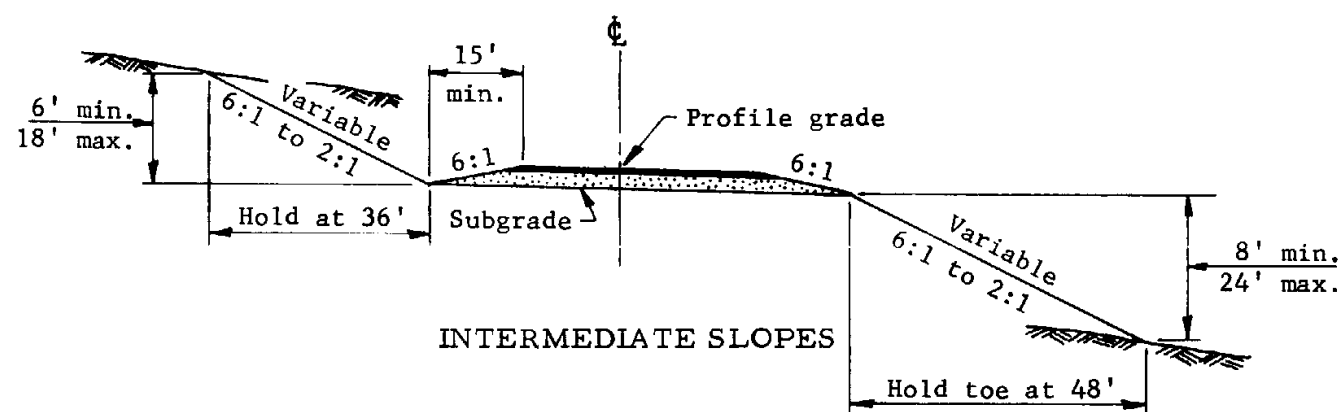
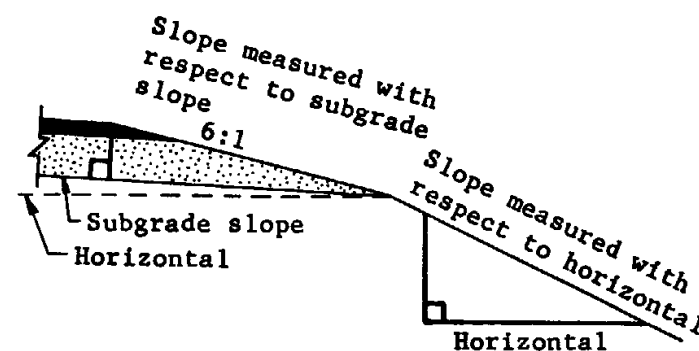
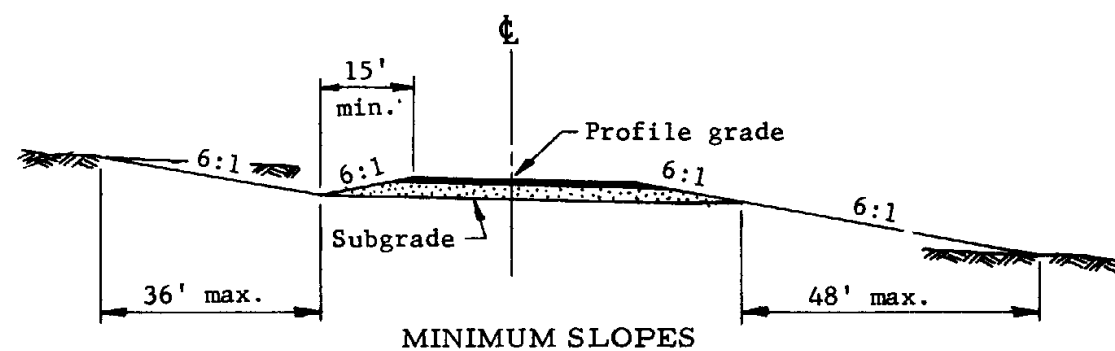
B. P. R. REGION	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZ.				
7 1/2" / 10	5" / 10	1 5" / 10	5" / 10	5" / 10	1" / 4

RAILROAD CROSSING SIGNS	----- Advance Warning X Buck Flashing Light
RAILROAD TRACK	-----
WELL OR PUMP HOUSE	-----
SURVEY MONUMENT	----- (1)-(2) ----- New Exist.
R/W MARKER	----- (1)-(2) ----- New Exist.
MILE POST	----- New Exist.
ANGLE POINT AND ANGLE	----- (1)-(2) ----- New Exist.

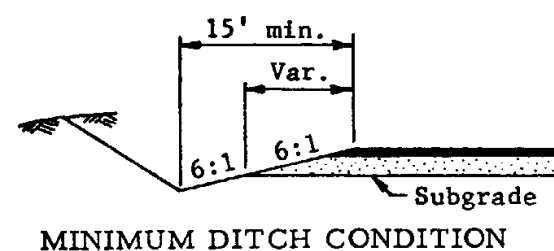
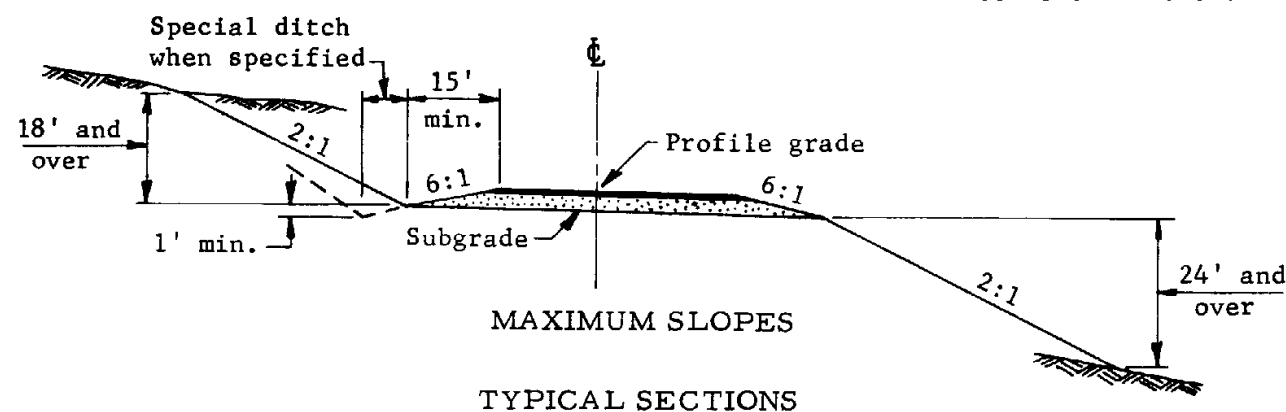


(1) New: No. 1 Rapidograph line width.
(2) Existing: No. 00 Rapidograph line width.
(Back of plan sheet)

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
PLANS SYMBOLS			
Drawn	R.A.F. 8/67	Drawing No.	
Traced			
Checked	J.P.O. 9/10 5-68		
Approved Engr. Plans	W. H. H. 5-68	C-1.01	



NOTE: Std. slope
rounding not shown.
See General Notes.



GENERAL NOTES

The desirable maximum embankment slope rate shall be 4:1 within interchange and grade separation areas.

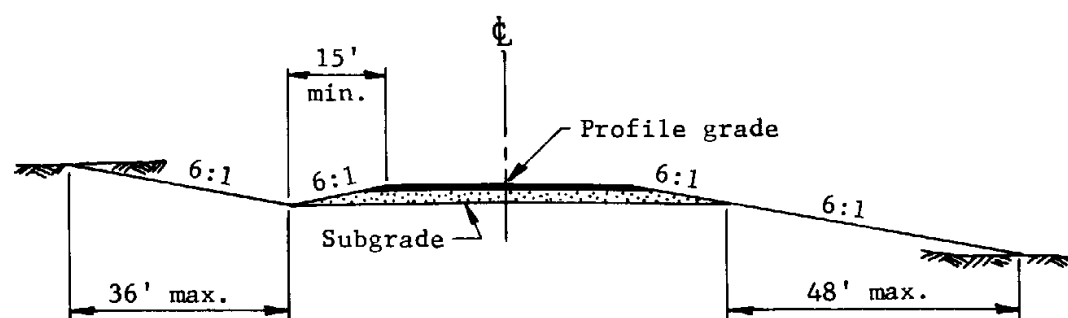
See Plans for details of; roadway width, cut ditch, type and thickness of roadway surfacing, and superelevation.

Standard cut and embankment slopes as shown on this sheet may be superseded by special slopes where shown on Plans.

For cuts up to 6' use 5' semi-tangents for slope rounding. For each additional foot of cut add 1' to semi-tangent to 11' maximum.

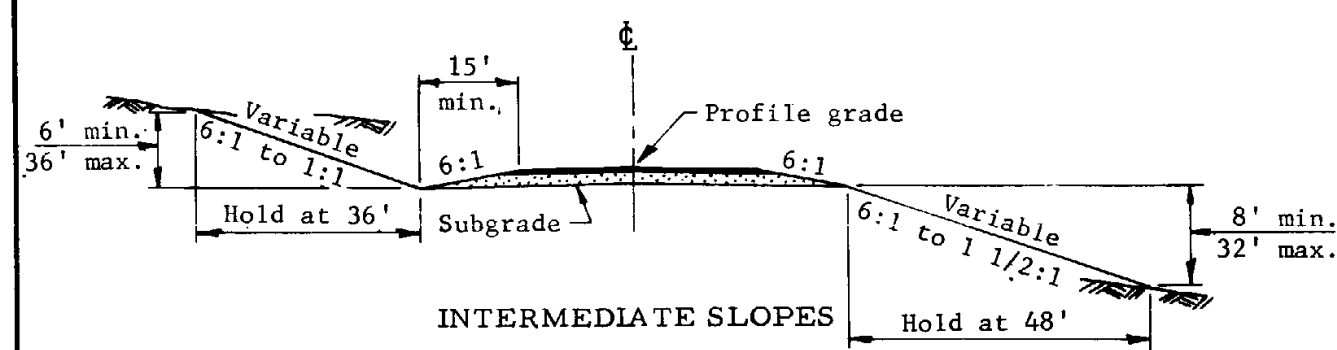
Should median slopes intersect see design supplement sheet.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
SLOPES INTERSTATE AND CLASS A-A ROADWAYS			
Drawn	R.A.F. 11-67	Drawing No. C-2.01	
Traced	R.A.F. 11-67		
Checked	J.P.O. 11-67		
Approved Engr. Plans	W. H. H. 5-68		

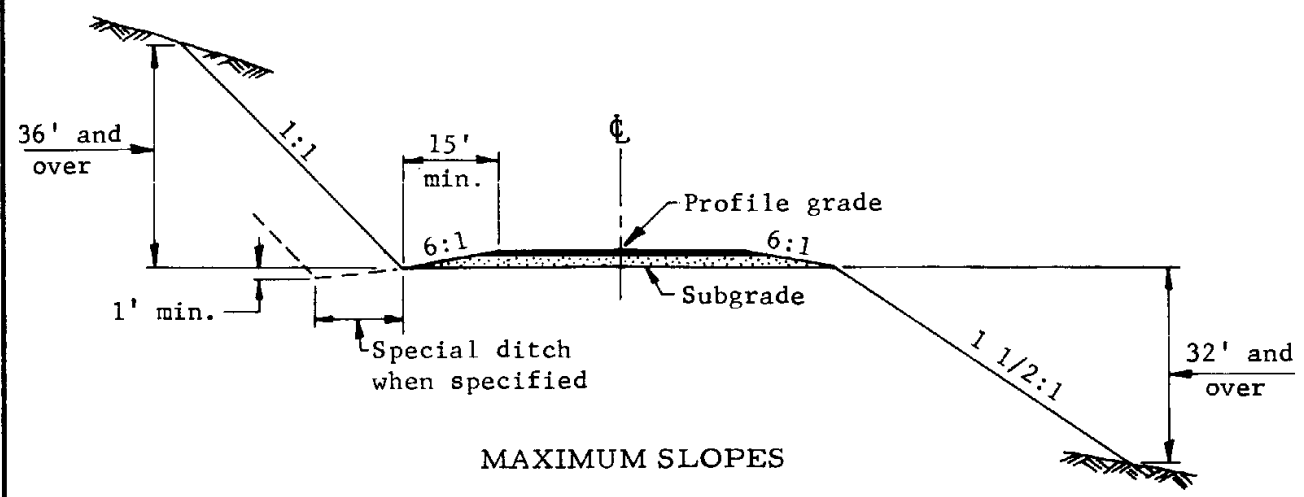


MINIMUM SLOPES

NOTE: Std. slope rounding not shown.
See General Notes.

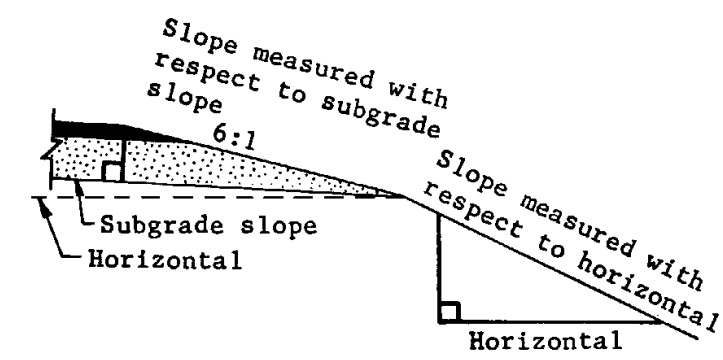


INTERMEDIATE SLOPES

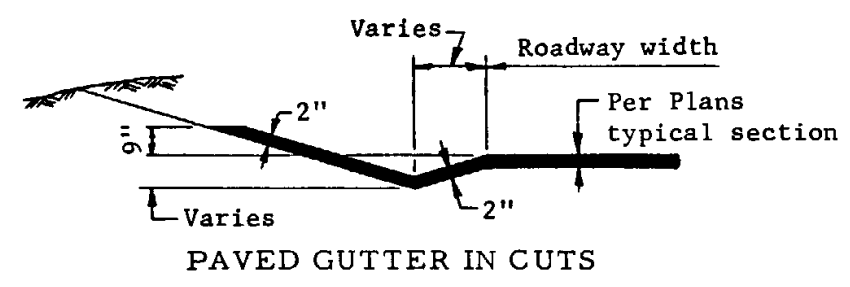


MAXIMUM SLOPES

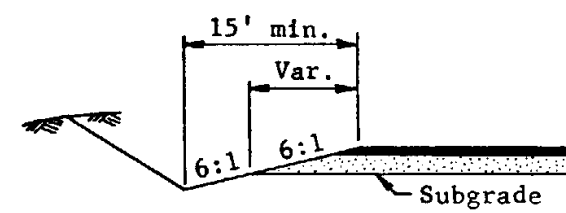
TYPICAL SECTIONS



DETAIL ILLUSTRATING
SUBGRADE & EMBANKMENT
SLOPE CONTROL



PAVED GUTTER IN CUTS

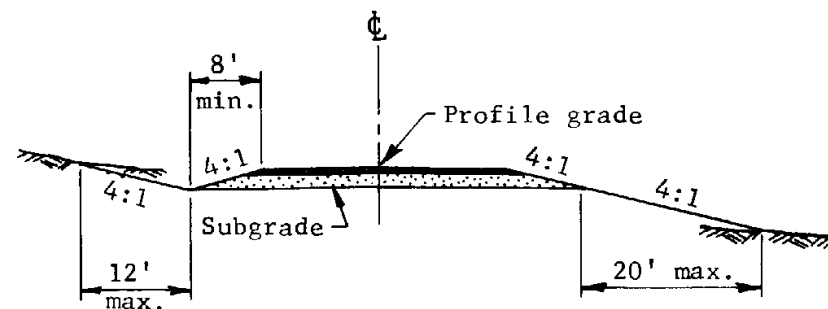


MINIMUM DITCH CONDITION

GENERAL NOTES

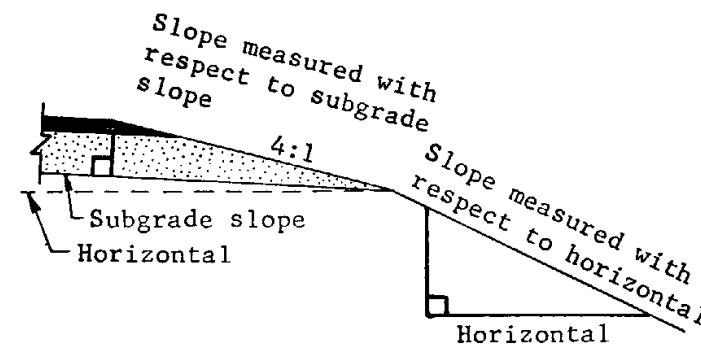
See Plans for details of; roadway width, cut ditch, type and thickness of roadway surfacing, superelevation, and curve widening.
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For cuts up to 6' use 5' semi-tangents for slope rounding. For each additional foot of cut add 1' to semi-tangent to 11' maximum.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
SLOPES CLASS A & B ROADWAYS			
Drawn	S.L.T. 11-67	Drawing No. C-2.02	
Traced	R.A.F. 11-67		
Checked	J.P.O. 11-67		
Approved Engr. Plans	W. Heidecker 5-68		

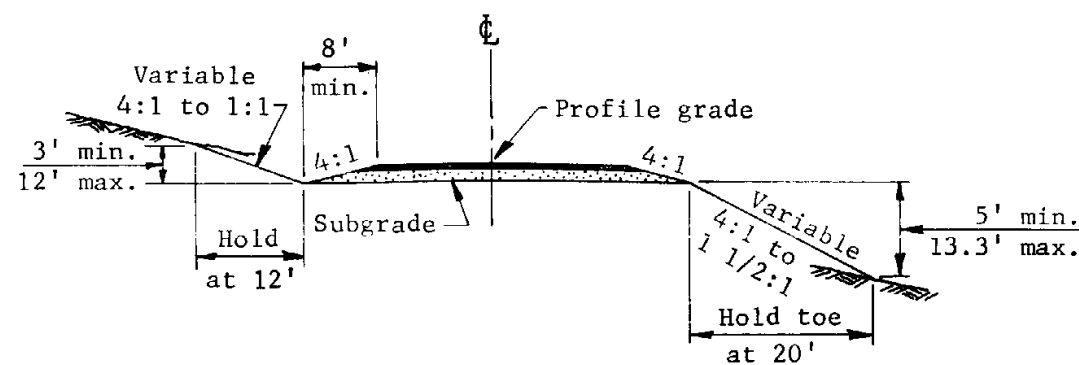


MINIMUM SLOPES

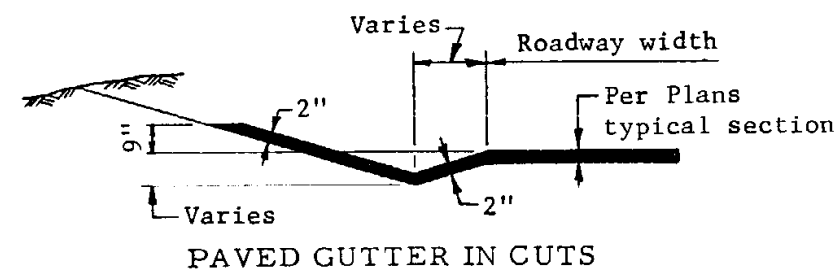
NOTE: Std. slope rounding not shown.
See General Notes.



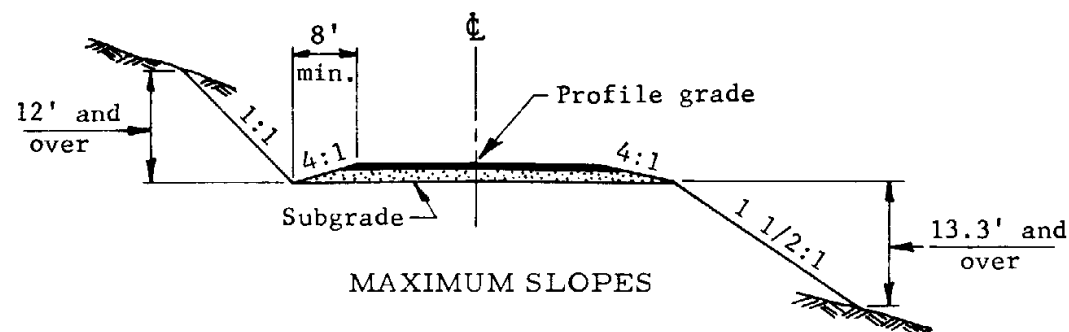
DETAIL ILLUSTRATING
SUBGRADE & EMBANKMENT
SLOPE CONTROL



INTERMEDIATE SLOPES

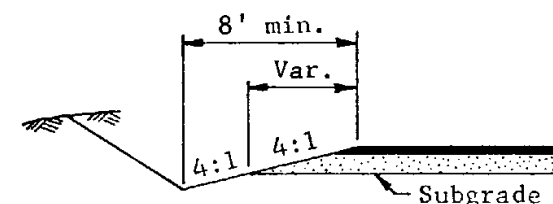


PAVED GUTTER IN CUTS



MAXIMUM SLOPES

TYPICAL SECTIONS



MINIMUM DITCH CONDITION

GENERAL NOTES

See Plans for details of; roadway width, cut ditch, type and thickness of roadway surfacing, superelevation, and curve widening.

Standard cut and embankment slopes as shown on this sheet may be superseded by special slopes where shown on Plans.

For cuts up to 6' use 5' semi-tangents for slope rounding. For each additional foot of cut add 1' to semi-tangent to 11' maximum.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

SLOPES CLASS C & D ROADWAYS

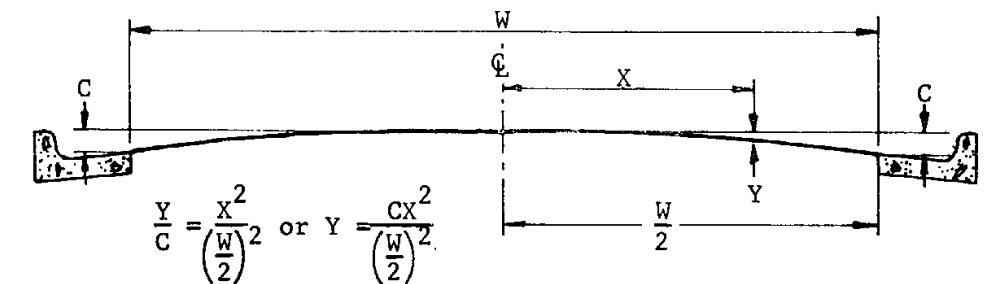
Drawn	S.L.T. 11-67	Drawing No. C-2.03
Traced	R.A.F. 11-67	
Checked	J.P.O. 11-67	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

CUMULATIVE PERCENT OF CROWN "C" FOR EACH FOOT RIGHT OR LEFT OF C

X →	2'	4'	6'	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'	32'	34'	36'	38'	40'	42'	44'
90	0.20	0.79	1.78	3.16	4.94	7.11	9.68	12.64	16.00	19.75	23.90	28.44	33.38	38.72	44.44	50.57	57.09	64.00	71.31	79.01	87.11	95.61
88	0.21	0.83	1.86	3.31	5.17	7.44	10.12	13.22	16.74	20.66	25.00	29.75	34.92	40.50	46.49	52.89	59.71	66.94	74.59	82.64	91.12	C
86	0.22	0.87	1.95	3.46	5.41	7.79	10.60	13.85	17.52	21.63	26.18	31.15	36.56	42.40	48.67	55.38	62.52	70.09	78.10	86.53	95.40	
84	0.23	0.91	2.04	3.63	5.67	8.16	11.11	14.51	18.37	22.68	27.44	32.65	38.32	44.44	51.02	58.05	65.53	73.47	81.86	90.70	C	
82	0.24	0.95	2.14	3.81	5.95	8.57	11.66	15.23	19.27	23.80	28.79	34.27	40.21	46.64	53.54	60.92	68.77	77.10	85.90	95.18		
80	0.25	1.00	2.25	4.00	6.25	9.00	12.25	16.00	20.25	25.00	30.25	36.00	42.25	49.00	56.25	64.00	72.25	81.00	90.25	C		
78	0.26	1.05	2.37	4.20	6.57	9.47	12.89	16.83	21.30	26.30	31.82	37.87	44.44	51.54	59.17	67.32	76.00	85.21	94.94			
76	0.28	1.11	2.49	4.43	6.93	9.97	13.57	17.73	22.44	27.70	33.52	39.89	46.81	54.29	62.33	70.91	80.06	89.75	C			
74	0.29	1.17	2.63	4.67	7.30	10.52	14.32	18.70	23.67	29.22	35.35	42.07	49.38	57.27	65.74	74.80	84.44	94.67				
72	0.31	1.23	2.78	4.94	7.72	11.11	15.12	19.75	25.00	30.86	37.35	44.44	52.16	60.49	69.44	79.01	89.20	C				
70	0.33	1.31	2.94	5.22	8.16	11.76	16.00	20.90	26.45	32.65	39.51	47.02	55.18	64.00	73.47	83.59	94.37					
68	0.35	1.38	3.11	5.54	8.65	12.46	16.95	22.15	28.03	34.60	41.87	49.83	58.48	67.82	77.85	88.58	C					
66	0.37	1.47	3.30	5.87	9.18	13.21	17.99	23.49	29.73	36.71	44.41	52.86	62.03	71.94	82.59	93.97						
64	0.39	1.56	3.52	6.25	9.77	14.06	19.14	25.00	31.64	39.06	47.27	56.25	66.02	76.56	87.89	C						
62	0.42	1.66	3.75	6.66	10.41	14.98	20.40	26.64	33.71	41.62	50.36	59.94	70.34	81.58	93.65							
60	0.44	1.78	4.00	7.11	11.11	16.00	21.78	28.44	36.00	44.44	53.78	64.00	75.11	87.11	C							
58	0.48	1.90	4.28	7.61	11.89	17.12	23.31	30.44	38.52	47.56	57.55	68.49	80.38	93.22								
56	0.51	2.04	4.59	8.16	12.76	18.37	25.00	32.65	41.33	51.02	61.73	73.47	86.22	C								
54	0.55	2.19	4.94	8.78	13.72	19.75	26.89	35.12	44.44	54.87	66.39	79.01	92.73									
52	0.59	2.37	5.33	9.47	14.79	21.30	28.99	37.87	47.93	59.17	71.60	85.21	C									
50	0.64	2.56	5.76	10.24	16.00	23.04	31.36	40.96	51.84	64.00	77.44	92.16										
48	0.69	2.78	6.25	11.11	17.36	25.00	34.03	44.44	56.25	69.44	84.03	C										
46	0.76	3.02	6.81	12.10	18.90	27.22	37.05	48.39	61.25	75.61	91.49											
44	0.83	3.31	7.44	13.22	20.66	29.75	40.50	52.89	66.94	82.64	C											
42	0.91	3.63	8.16	14.51	22.68	32.65	44.44	58.05	73.47	90.70												
40	1.00	4.00	9.00	16.00	25.00	36.00	49.00	64.00	81.00	C												
38	1.11	4.43	9.97	17.73	27.70	39.89	54.29	70.91	89.75													
36	1.23	4.94	11.11	19.75	30.86	44.44	60.49	79.01	C													
34	1.38	5.50	12.46	22.15	34.60	49.83	67.82	88.58														
32	1.56	6.25	14.06	25.00	39.06	56.25	76.56	C														
30	1.78	7.11	16.00	28.44	44.44	64.00	87.11															
28	2.04	8.16	18.37	32.65	51.02	73.47	C															
26	2.37	9.47	21.30	37.87	59.17	85.21																
24	2.78	11.11	25.00	44.44	69.44	C																
22	3.31	13.22	29.75	52.89	82.64																	
20	4.00	16.00	36.00	64.00	C																	
18	4.94	19.75	44.44	79.01																		
16	6.25	25.00	56.25	C																		
14	8.16	32.65	73.47																			
12	11.11	44.44	C																			

FORMULA



USE OF TABLE

Example:

Assume W = 40 ft. and C = 0.45 ft.
Find Y for X = 8 ft.

Table shows Y = 16.00% of C,
or 0.045 X 0.16 = 0.072 ft.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

PARABOLIC CROWN FORMULA AND TABLE

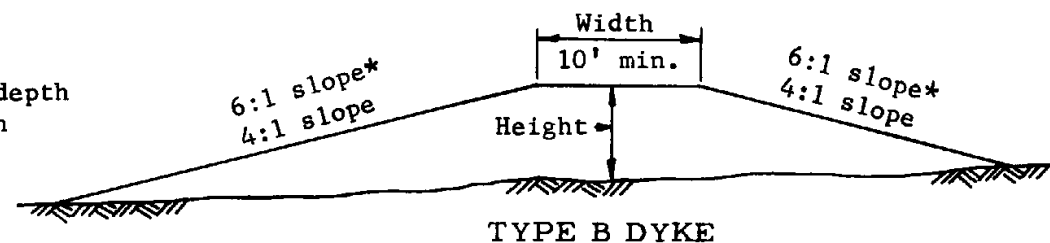
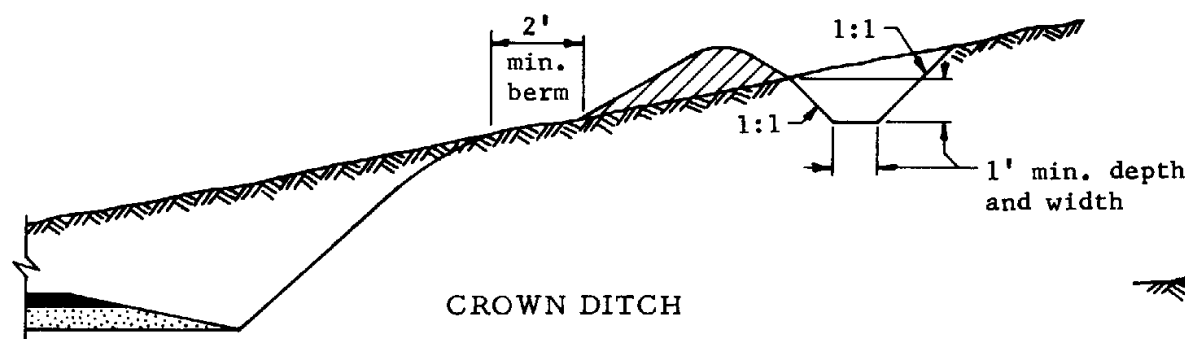
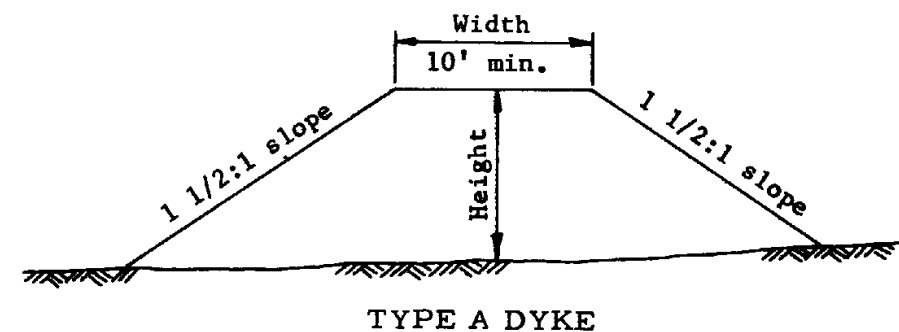
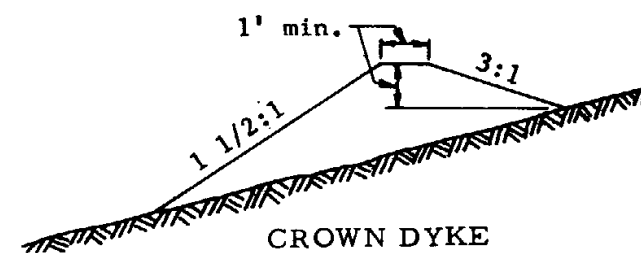
Drawn L. McD. 6-41
Traced S. L. T. 7-67
Checked J. P. O. 8-68
Approved
Engr. Plans *[Signature]* 5-68

Drawing No.

C-2.04

Rev.

W = FULL WIDTH OF ROADWAY - FEET



* TYPE M DYKE

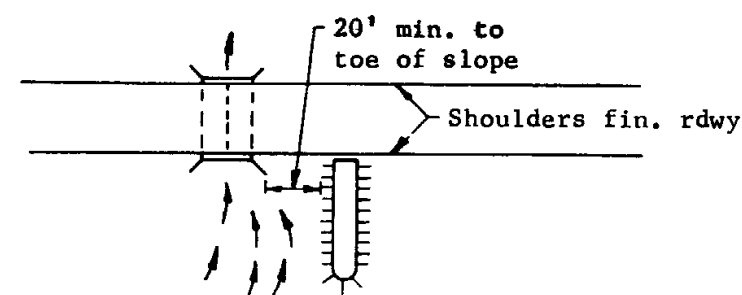
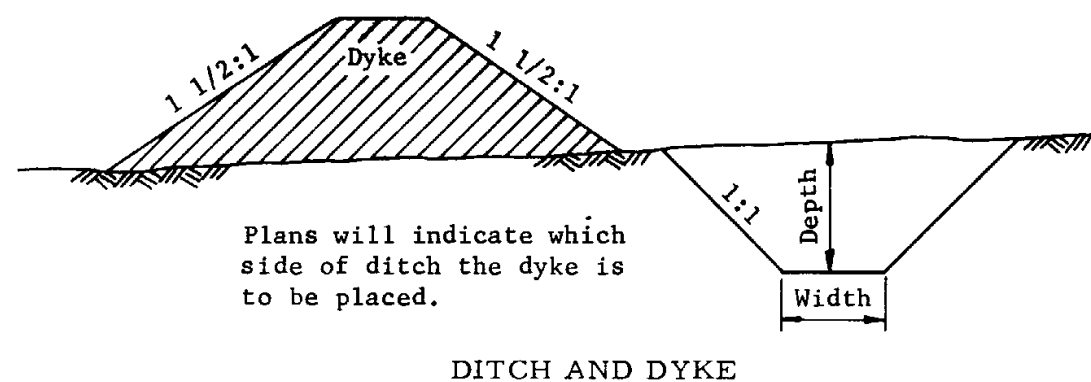
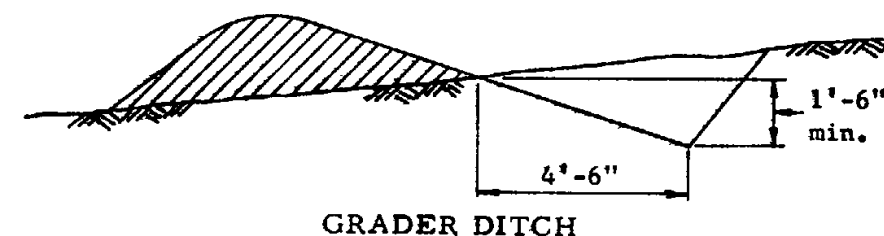
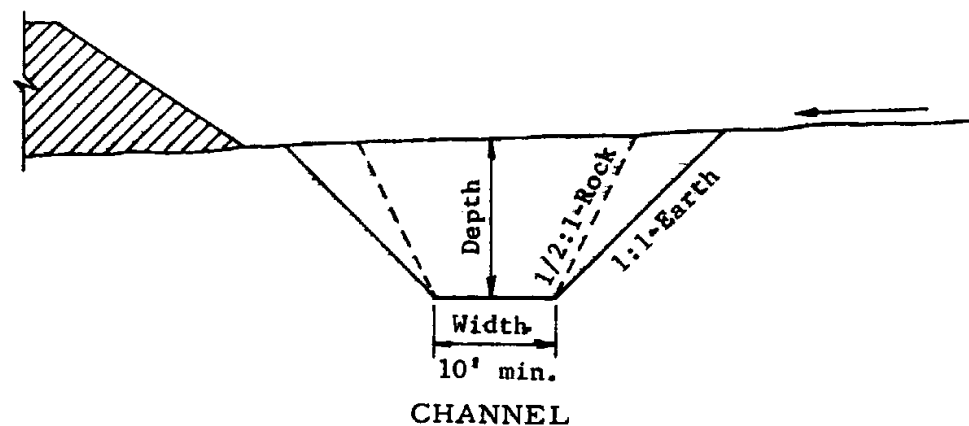
GENERAL NOTES

Bituminous or soil cement protection shall be applied to dyke surfaces as called for on Plans.

Dimensions of ditches and dykes, as shown on Plans, are width, depth or height and length.

Grader Ditches and crown ditches or dykes shall be constructed with a minimum grade to prevent excessive erosion. Ditch outlets should be provided where possible.

Ditch sections shown may be varied by the Engineer.



Place dykes at structures to create a water cushion.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

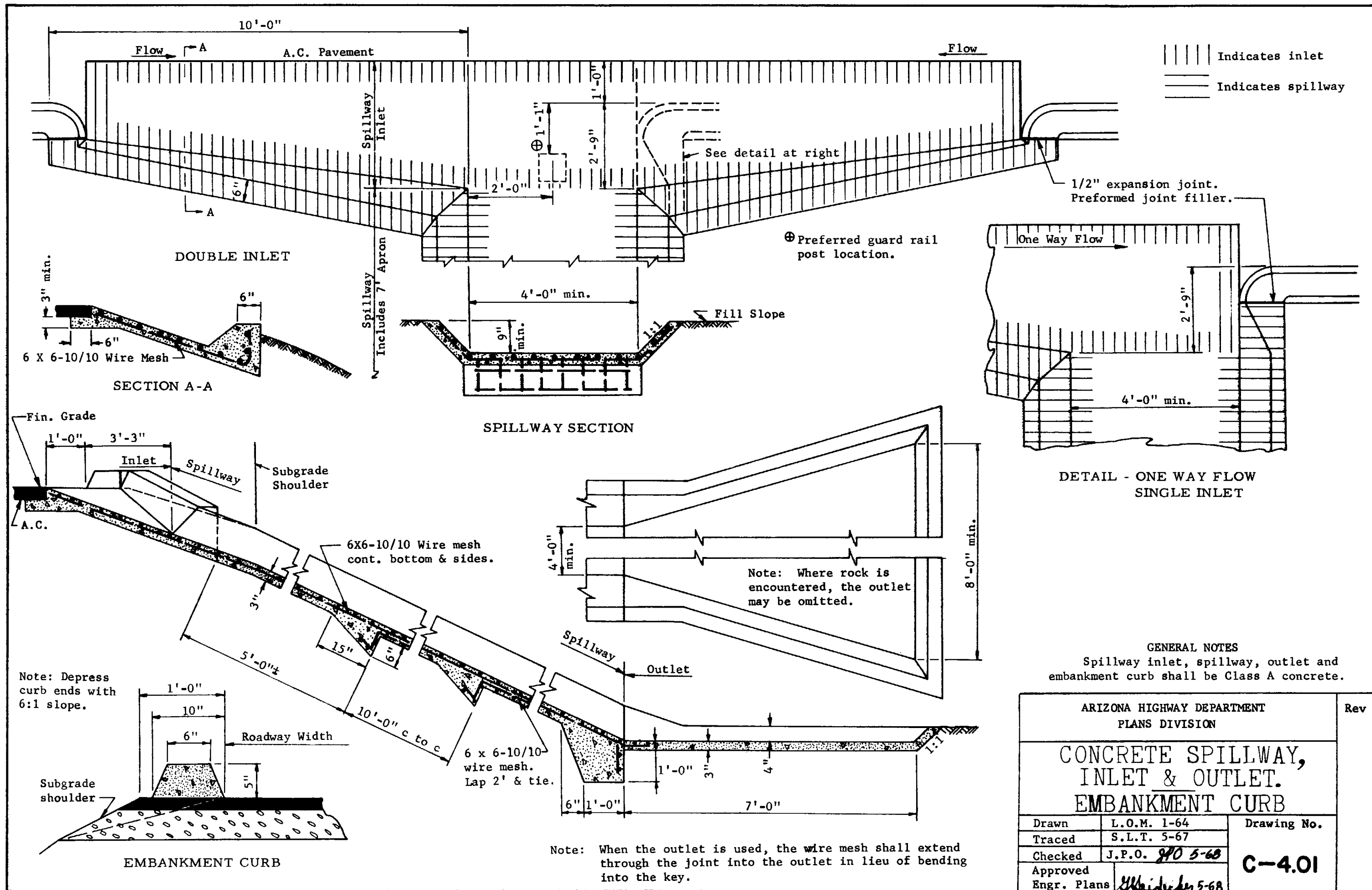
DITCHES AND DYKES

Drawn	G.H. 12-45
Traced	R.A.F. 10-67
Checked	J.P.O. 8PD 5-68
Approved	M. Heidricher 5-68
Engr. Plans	

Drawing No.

C-3.01

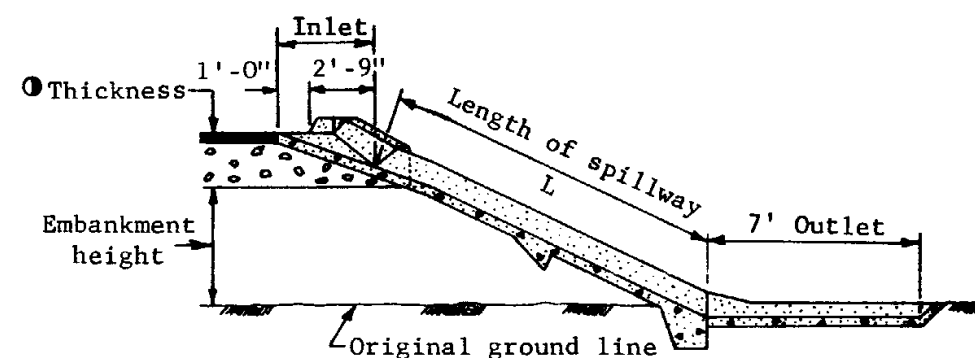
Rev



		C-2.02 Slopes																															
		C-2.01 Slopes																															
		Embankment Height																															
●		5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'	25'	26'	27'	28'	29'	30'	31'	32'				
12"		(32)	(37)	(43)	(49)	(50)																											
13"		(33)	(38)	(44)		(51)																											
14"		(33)	(38)	(44)			(51)																										
15"		(34)	(39)	(45)				(52)																									
16"		(34)	(39)	(45)					(53)																								
17"		(35)	(40)	(46)						(54)																							
18"		(35)	(40)	(46)							(55)																						
19"		(36)	(41)	(47)								(56)																					
20"		(36)	(41)	(47)									(57)																				
21"		(37)	(42)	(48)										(58)																			
22"		(37)	(42)	(48)											(59)																		
23"		(38)	(43)	(49)													(60)																
24"		(38)	(43)	(49)														(61)															
25"		(39)	(44)	(50)															(62)														
26"		(39)	(44)	(50)																(63)													
27"		(40)	(45)	(51)																	(64)												
28"		(40)	(45)	(51)																		(65)											
29"		(41)	(46)	(52)																			(66)										
30"		(41)	(46)	(52)																				(67)									
31"		(42)	(47)	(53)																					(68)								
32"		(42)	(47)	(53)																						(69)							
33"		(43)	(48)	(54)																							(70)						
34"		(43)	(48)	(54)																								(71)					
35"		(44)	(49)	(55)																									(72)				
36"		(44)	(49)	(55)																										(72)			

		C-2.03 Slopes											
		Embankment Height											
●		5'	6'	7'	8'	9'	10'	11'	12'	13'			
12"													
13"		(22)											
14"			(23)										
15"				(24)									
16"					(25)								
17"						(26)							
18"							(27)						
19"								(28)					
20"									(29)				
21"										(30)			
22"											(31)		
23"												(32)	
24"													(33)
25"													
26"													
27"													
28"													
29"													
30"													
31"													
32"													
33"													
34"													
35"													
36"													

● Thickness of pavement structure



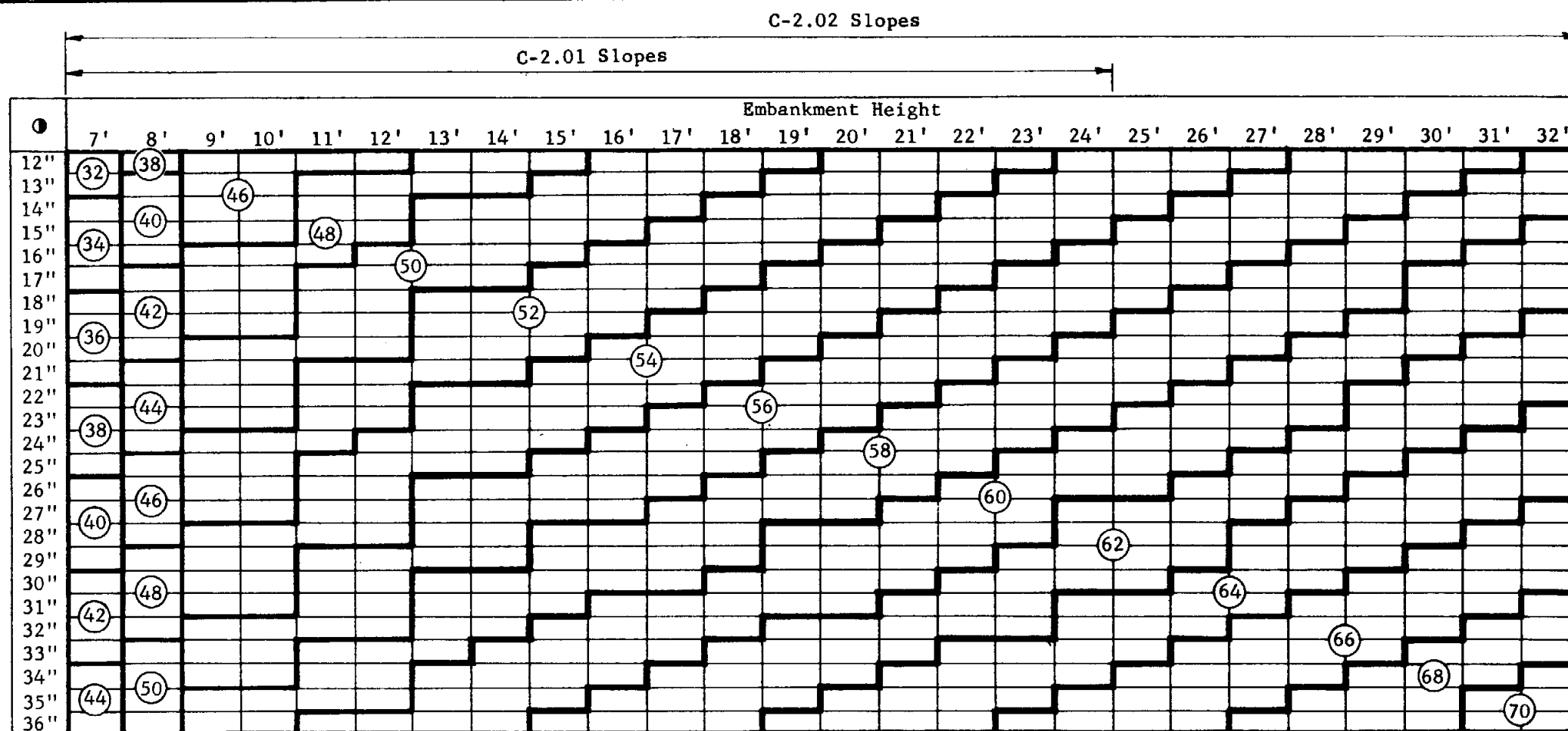
GENERAL NOTES

For C-2.01 slopes with emb. height over 24', L = L for 24' emb. height from table + 2.24(emb. height - 24).

For C-2.02 slopes with emb. height over 32', L = L for 32' emb. height from table + 1.8(emb. height - 32).

For C-2.03 slopes with emb. height over 13', L = L for 13' emb. height from table + 1.8(emb. height - 13).

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CONCRETE SPILLWAY LENGTH TABLE			
Drawn	D.G. 12-67	Drawing No. C-4.03	
Traced	D.G. 1-68		
Checked	J.P.O. 980 5-68		
Approved Engr. Plans	<i>St. Heidrich</i> 5-68		

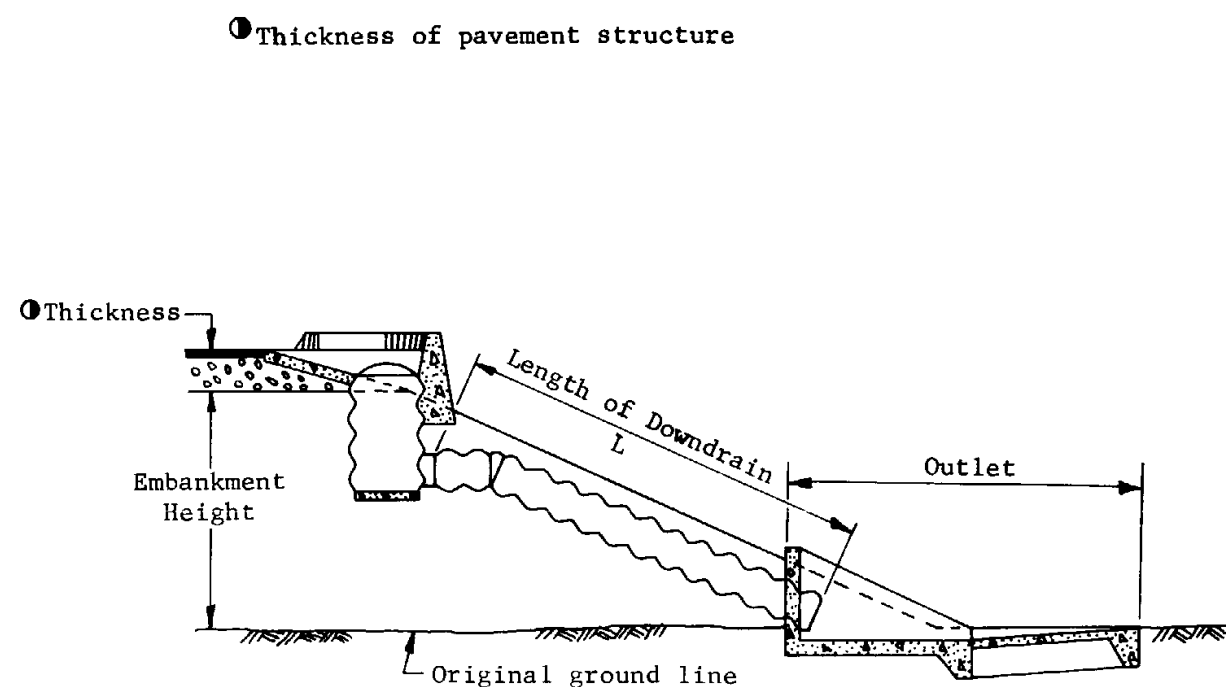
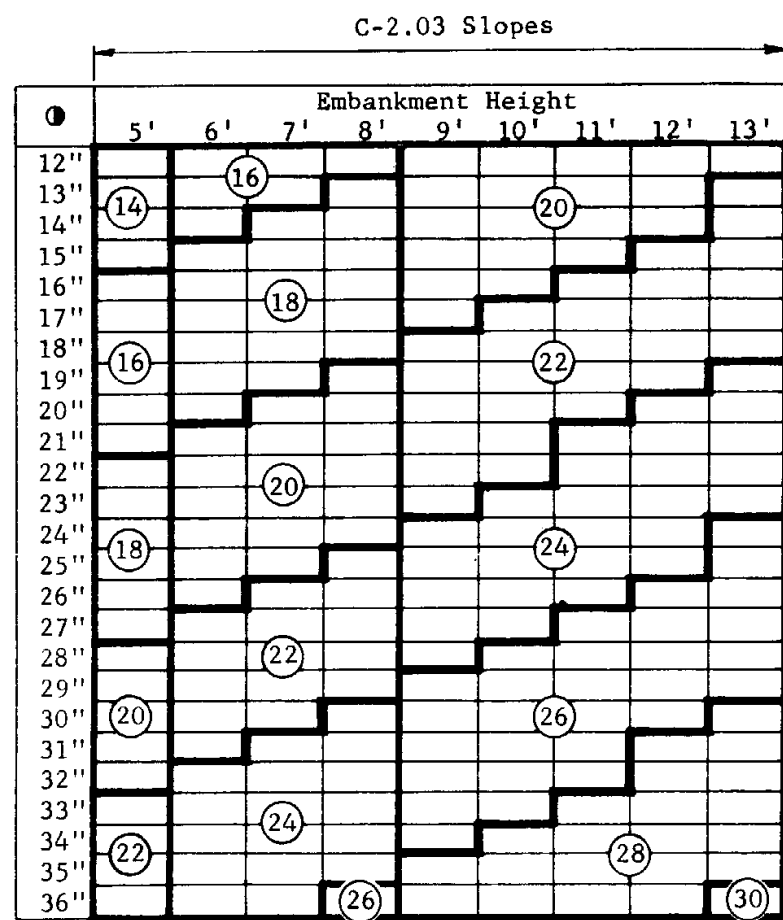


GENERAL NOTES

For C-2.01 slopes with emb. height over 24', L = L for 24' emb. height from table + 2.24(emb. height - 24).

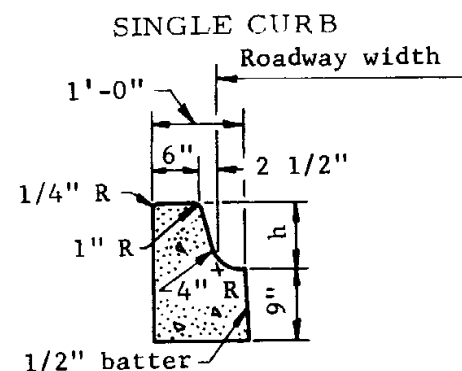
For C-2.02 slopes with emb. height over 32', L = L for 32' emb. height from table + 1.8(emb. height - 32).

For C-2.03 slopes with emb. height over 13', L = L for 13' emb. height from table + 1.8(emb. height - 13).



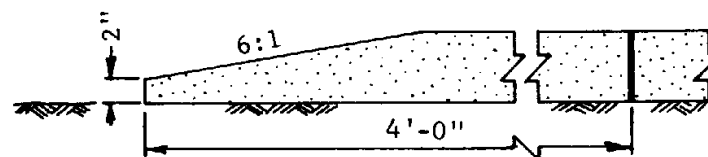
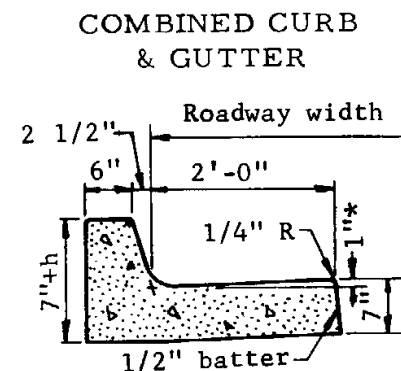
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
C.M.P. DOWNDRAIN LENGTH TABLE		
Drawn	J.W. & D.G. 2-67	Drawing No. C-4.04
Traced	R.A.F. 12-67	
Checked	J.P.O. 800 5-68	
Approved Engr. Plans	5-68	

NOTE: Radii shown for single curbs are typical throughout for respective type.
h=curb height as shown on Plans.

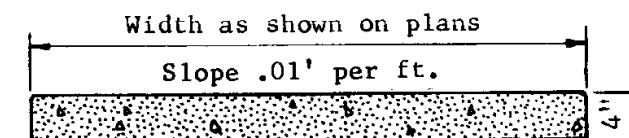


TYPE "A"

For 6" curb height or over

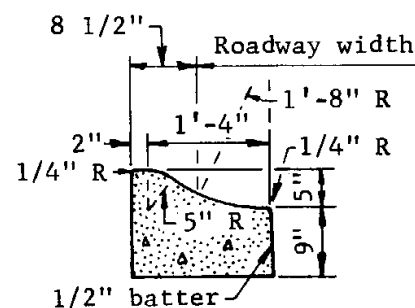


CURB TERMINAL SECTION

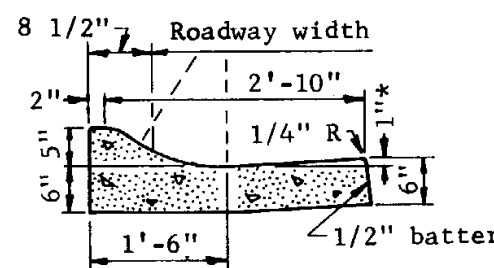


Sidewalk shall be single course Class A concrete, sweat finished and jointed with a 1/4" deep jointing tool at centers approximately equal to the width of the sidewalk.
Sidewalk shall be scored to a depth of 1" at intervals matching the joints in the adjacent curb.
Sidewalk shall be edged with a 1/4" radius edging tool.

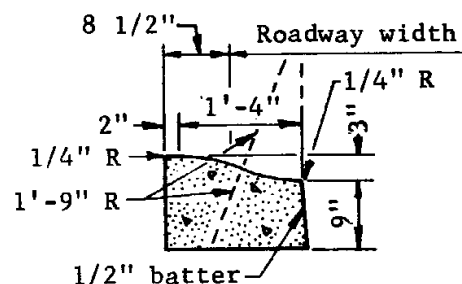
CONCRETE SIDEWALK



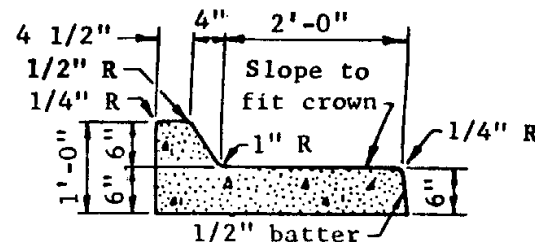
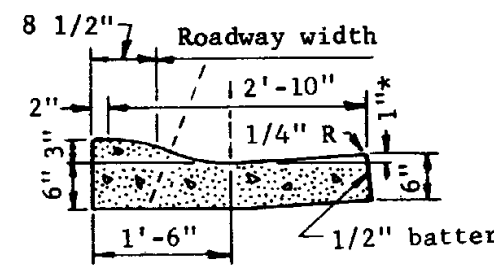
TYPE "E"



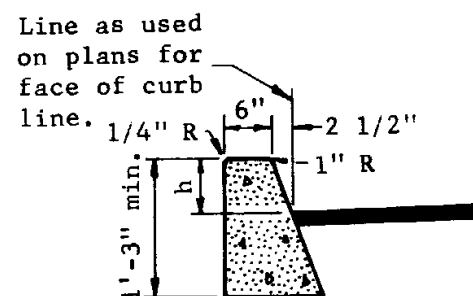
TYPE "F"



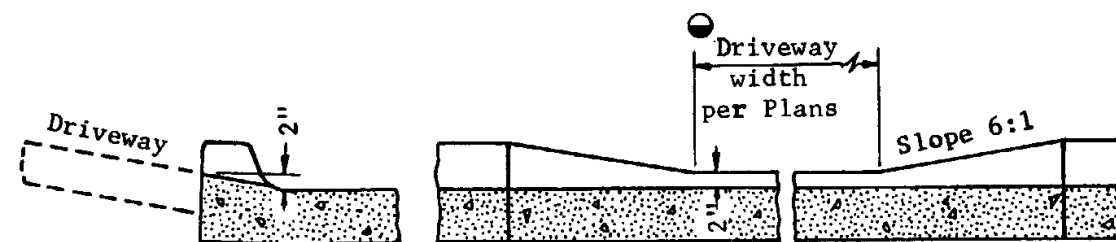
TYPE "G"



TYPE "H"

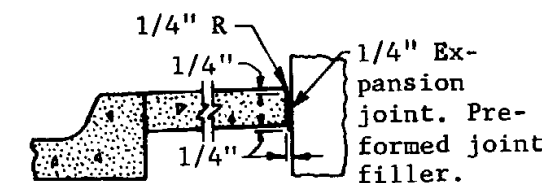


VALLEY GUTTER



Center joint required if driveway width over 20'

DEPRESSED CURB FOR DRIVEWAY ENTRANCE



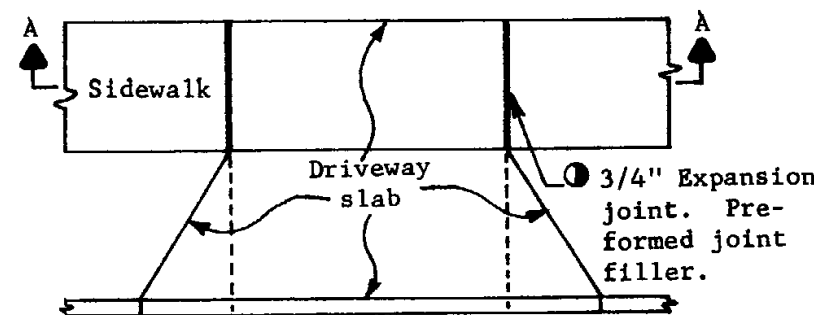
SIDEWALK EXPANSION JOINT

GENERAL NOTES

All curbs and gutters shall be single course, Class A concrete unless otherwise noted on plans.
All curbs shall be trowel finished.
All gutter flow lines shall be troweled to an accurate grade for a width of 9".

Curbs, or curb and gutter, shall have a 1/4" joint extending all the way through the concrete at locations matching the joints in adjacent P.C.C. pavement; at approximately 15' centers when adjacent pavement is bituminous and at tangent points in curb returns and at structures. The joints may be open or with redwood filler left in place.

* When curb and gutter is located with the roadway section sloping away from the curb, the gutter slope shall match the roadway slope.



PLAN



SECTION A-A

Joint is required between driveway slab and adjacent sidewalk.

SIDEWALK AT DRIVEWAY

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

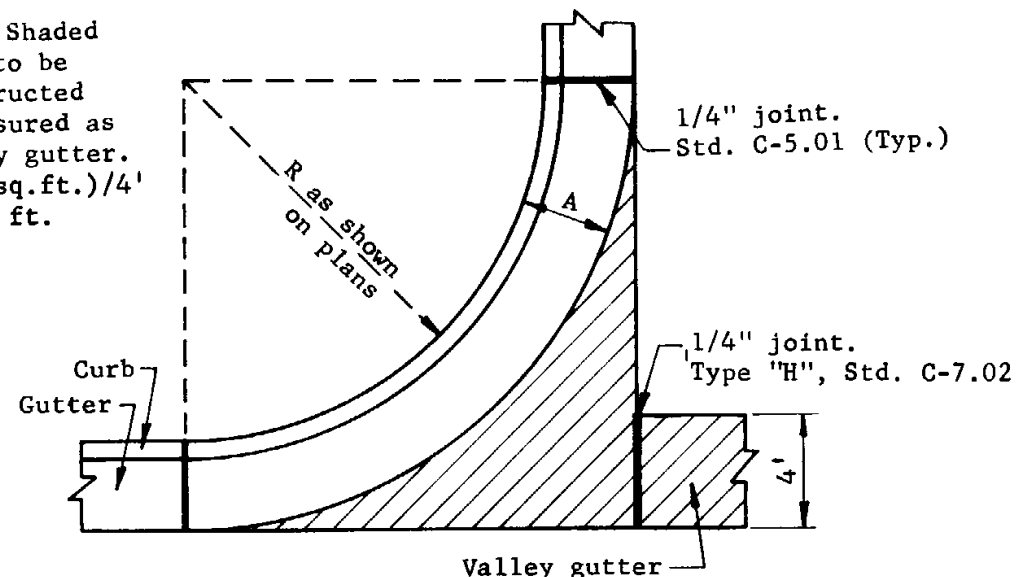
CURB, GUTTER, SIDEWALK & DRIVEWAY DETAILS

Drawn	O.K.	3-1935
Traced	R.A.F.	6-8-67
Checked	J.P.O.	8PO 5-68
Approved		
Engr. Plans	H. H. H. 5-68	

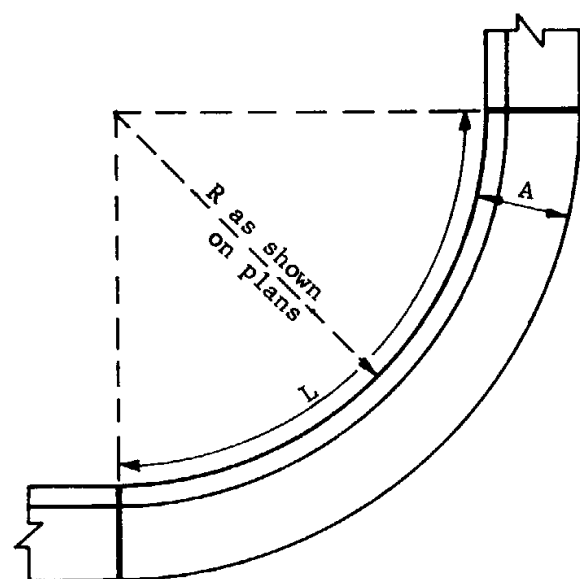
Drawing No.
C-5.01

Rev

NOTE: Shaded area to be constructed & measured as valley gutter. Area(sq.ft.)/4' =lin. ft.



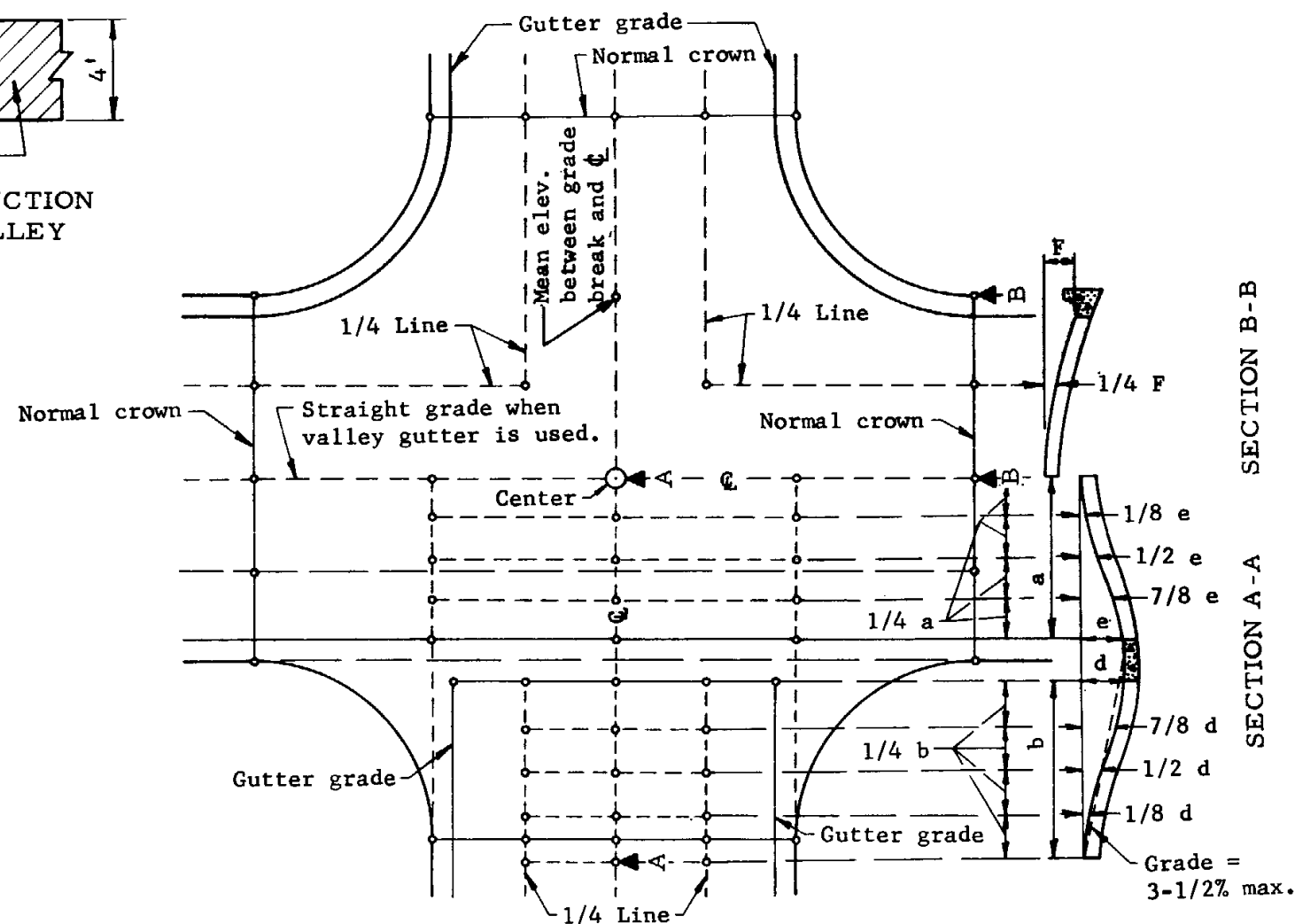
TYPICAL VALLEY GUTTER CONSTRUCTION AT STREET INTERSECTION OR ALLEY



CURB & GUTTER MEASUREMENT ON CURVES

Single curb and combined curb and gutter will be measured along the back of the curb.

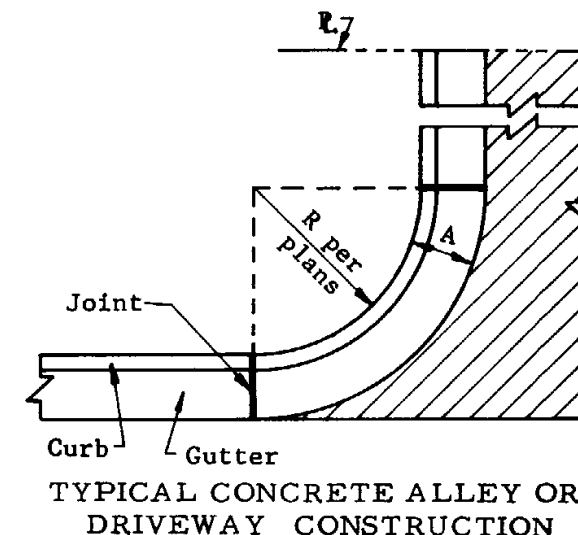
- A = Overall curb and gutter width.
d = Drop from point controlled by grade to outside edge of gutter.
F = Total crown from C elev. to gutter grade.
a = Distance from C to inside edge of gutter.
b = Distance from outside edge of gutter to point controlled by grade.
e = Drop from C to inside edge of gutter.



FORMULA FOR QUARTER POINTS

- S = Sum of intersecting pavement widths. (Distance between gutter grade lines.)
D = Drop from center of intersection to center of return
where S = 0' to 90', P = 0.17
" S = 91' to 100', P = 0.18
" S = 101' to 110', P = 0.19
" S = 111' to 136', P = 0.20
PD = Drop from center of intersection to quarter point.

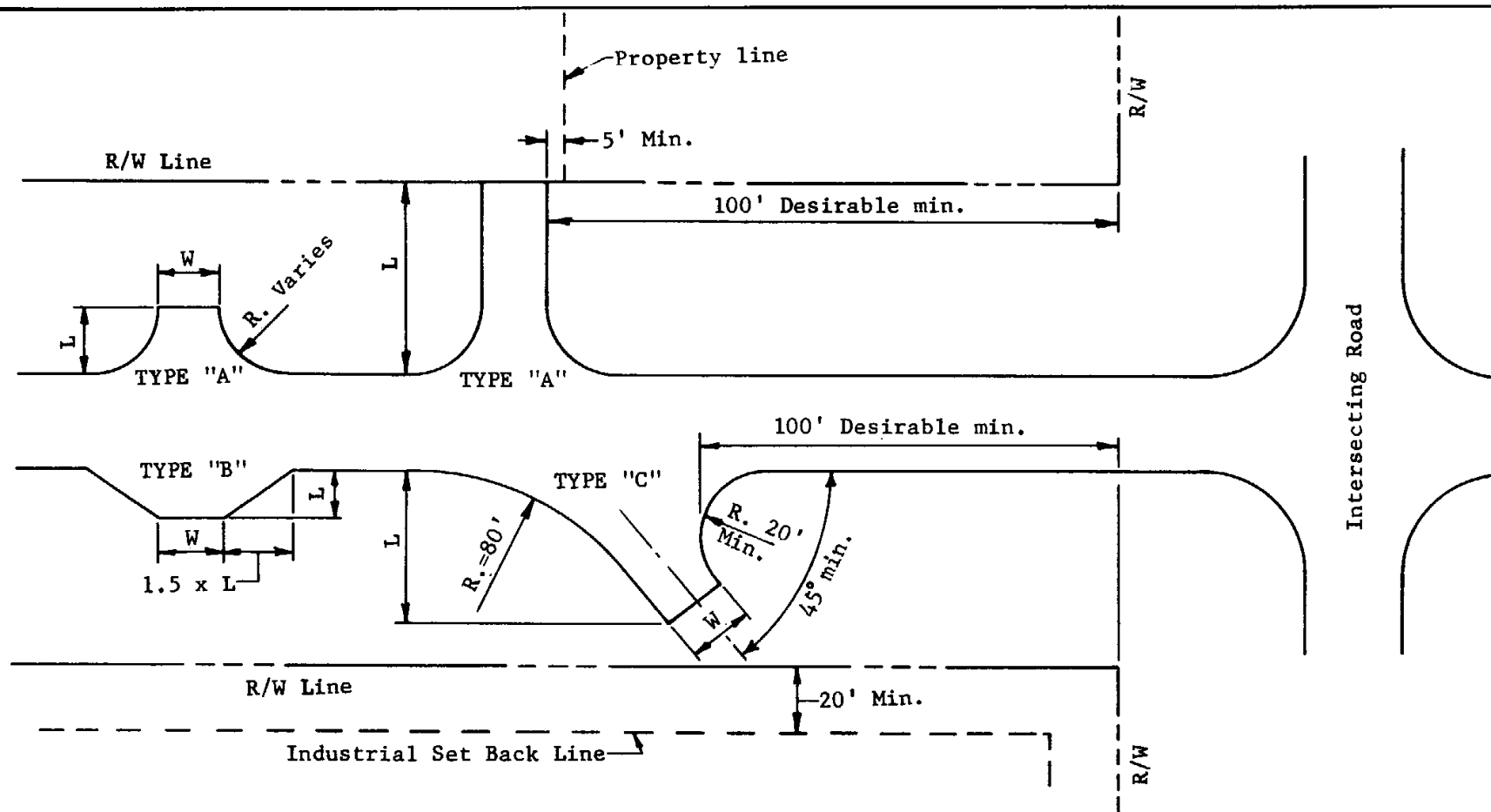
STREET INTERSECTION GRADES



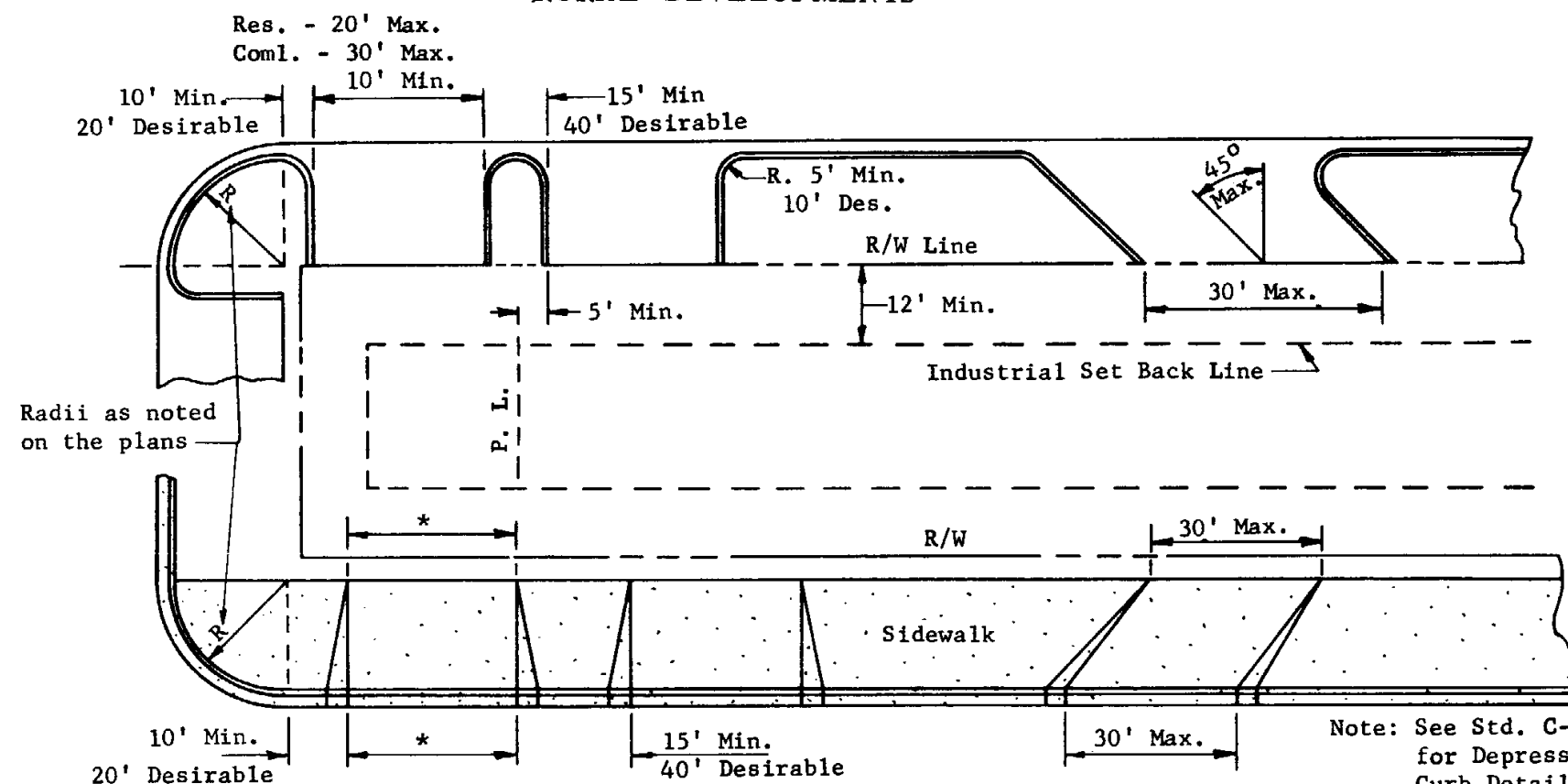
GENERAL NOTES
To determine the value of F, see roadway typical section.
For Curb and Gutter details, see Std. C-5.01.

SECTION B-B
SECTION A-A

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CURB & GUTTER MEASUREMENT & STREET INTERSECTION GRADES			
Drawn	O.K. & W.M.D.	Drawing No. C-5.02	
Traced	R.A.F. 9-16-66		
Checked	J.P.O. 870 5-68		
Approved Engr. Plans	8/16/68		



RURAL DEVELOPMENTS



URBAN DEVELOPMENTS

GENERAL NOTES

Paved Turnouts: W=10' Minimum & 40' Maximum.
Plans notation will be W x L, Surface Material, Type & Standard.
Example: 16' x 30' A.C.T.O. Type "A" Standard C-6.01.

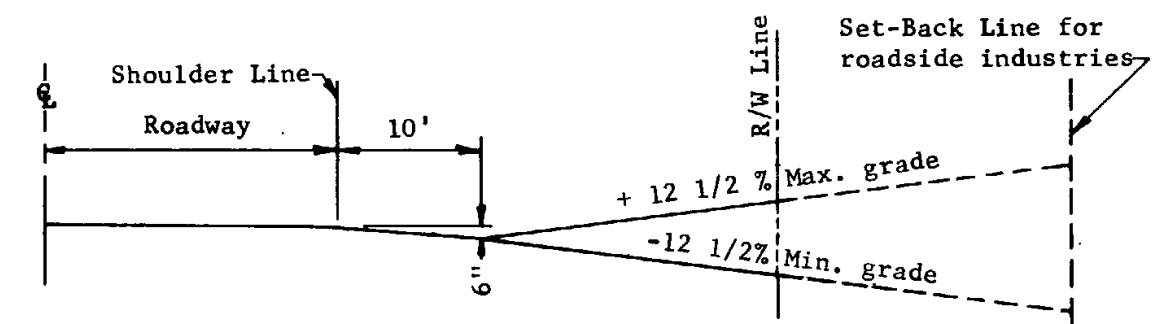
Base material shall be the same as that shown for main roadway, unless otherwise noted.

Excavation or Embankment for turnouts shall be included in quantities for main roadway.

Dimensions indicated as minimum shall be avoided wherever possible in favor of those indicated as desirable

Curbed driveways and depressed curbs shall be located as noted on Plans or as directed by the Engineer.

All radii shown are to back of curb.

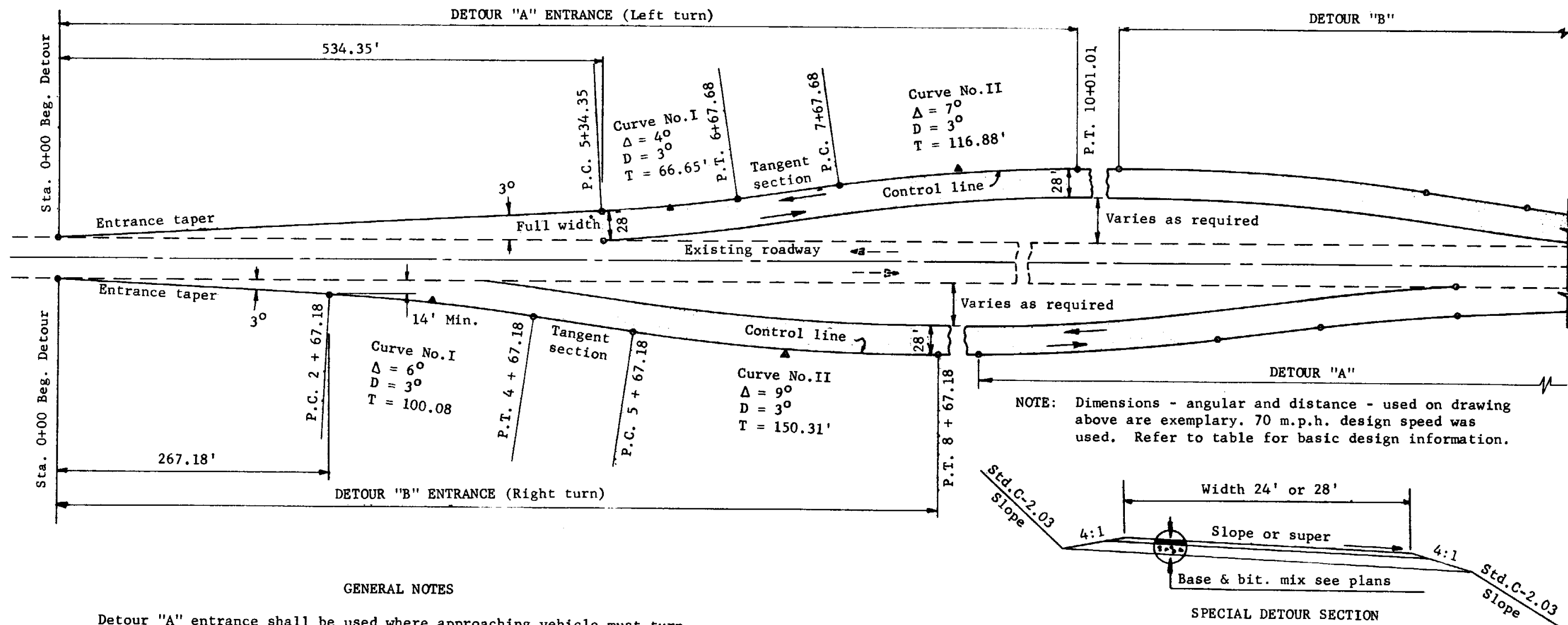


TYPICAL SECTION AT RURAL DRIVEWAY ENTRANCE
See Std. C-5.01 for Depressed Curb Details

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

TURNOUT & DRIVEWAY LAYOUT

Drawn	L. O. Moe 2-64	Drawing No.
Traced	R.A.F. 11-18-66	
Checked	J.P.O. 8-10-68	C-6.01
Approved Engr. Plans	H. H. H. 5-68	



GENERAL NOTES

Detour "A" entrance shall be used where approaching vehicle must turn left. Detour "B" shall be used where approaching vehicle must turn right. Detour from a horizontal curve: On the inside of the curve the detour take off shall be a curve, see table. On the outside a tangent take off shall be used. A vertical curve may be required to effect a smooth grade change.

The design speed shall be comparable between vertical and horizontal alignment.

The entrance design speed of a detour shall not be less than the normal posted speed of the existing roadway. The design speed for the remainder of the detour may be 20 m.p.h. less than the normal posted speed.

Any intermediate detour entrance may be designed on the basis of normal posted speed less 20 m.p.h. where visible construction activity has slowed traffic for the preceding 1/4 mile.

The minimum width of the detour shall be 28' for existing roadways 34' or wider and a minimum of 24' for existing roadways less than 34' in width.

The entrance taper for Detour "A" shall be extended until full detour width is attained. For Detour "B" the entrance taper shall be extended until a minimum of 14' is attained beyond the edge of existing roadway.

Any deviation from this standard must be approved by the Plans Engineer and Traffic Engineer and the Engineer shall submit the alignment and profile of the proposed change for their review.

Tangent Roadway		Curved Roadway			Entrance Design Speed	Max. Horizontal Curvature			
Entrance Design Speed	Entr.Taper Def'l. Angle	Exist. Horiz. Curve	Detour "A" Take off Curve	Detour "B" Take off Curve		Curve No. I		Curve No. II	
						D	Superelev.	D	Superelev.
70	3°	1°	2°	2°30'	70	3°	.05'/ft.	3°	.03'/ft.
60	3°	2°	3°	3°30'	60	3°	.02'/ft.	4°	.04'/ft.
50	4°	3°	4°	5°	50	4°	.015'/ft.	6°	.04'/ft.
40	6°	4°	5°	6°	40	6°	.015'/ft.	10°	.04'/ft.
		4°	5°	6°	30	10°	.015'/ft.	19°	.04'/ft.
		6°	7°	8°					
		7°	8°	9°					
		8°	9°	10°					

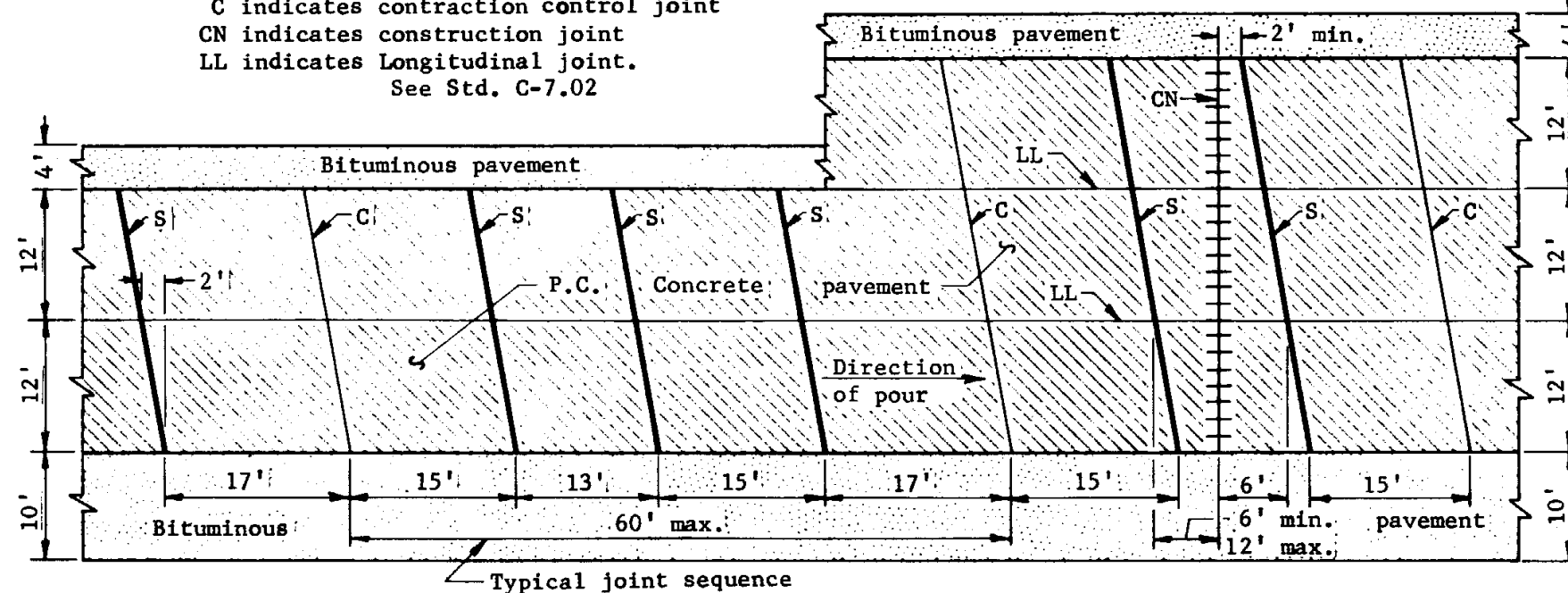
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

DETOUR ENTRANCE DESIGN TABLE

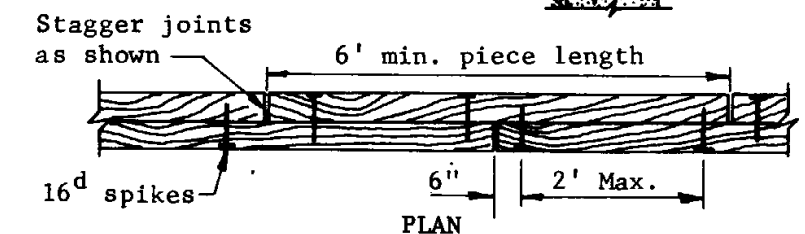
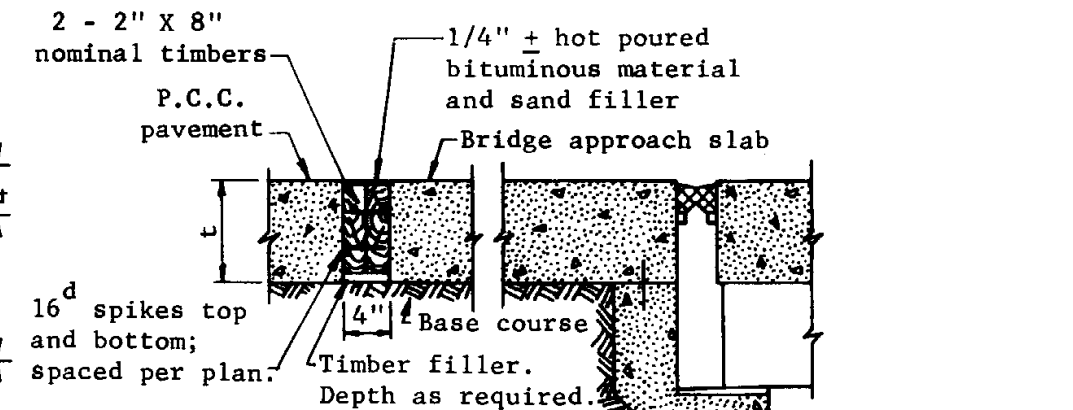
Drawn	J.P.O. 12-64	Drawing No. C-6.02
Traced	R.A.F. 12-66	
Checked	J.P.O. 9-5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

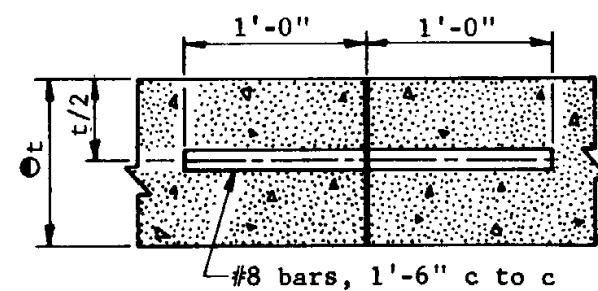
S indicates sawed contraction joint
C indicates contraction control joint
CN indicates construction joint
LL indicates Longitudinal joint.
See Std. C-7.02



PLAN
See General Notes

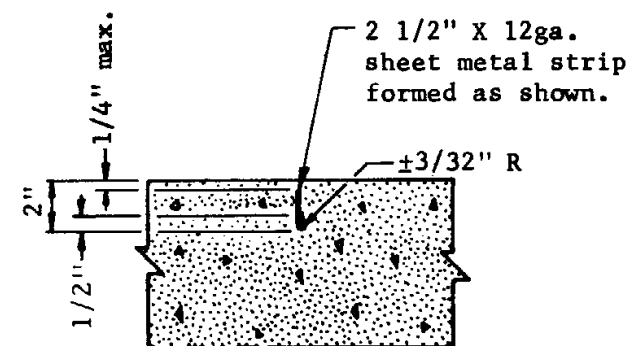


TRANSVERSE EXPANSION JOINT AT
BRIDGE APPROACH SLAB

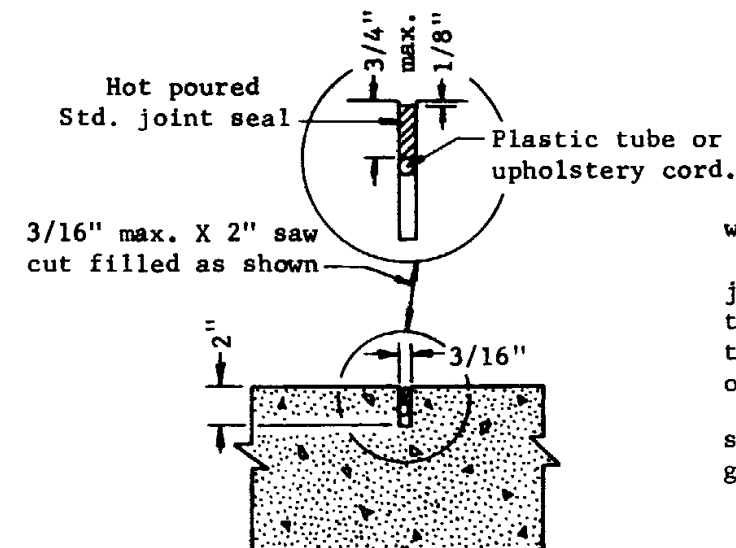


⊙ Indicates P.C.C. thickness

CONSTRUCTION JOINT
To be used at end of pour



INSERT TYPE
CONTROL JOINT



SAWED TYPE
CONTROL JOINT

GENERAL NOTES

All transverse joints shall be in line with joints in adjacent slabs.

At intersection of side roads or streets, joints shall be placed to give the intersection a symmetrical appearance while conforming to the cross section of the intersecting road or street.

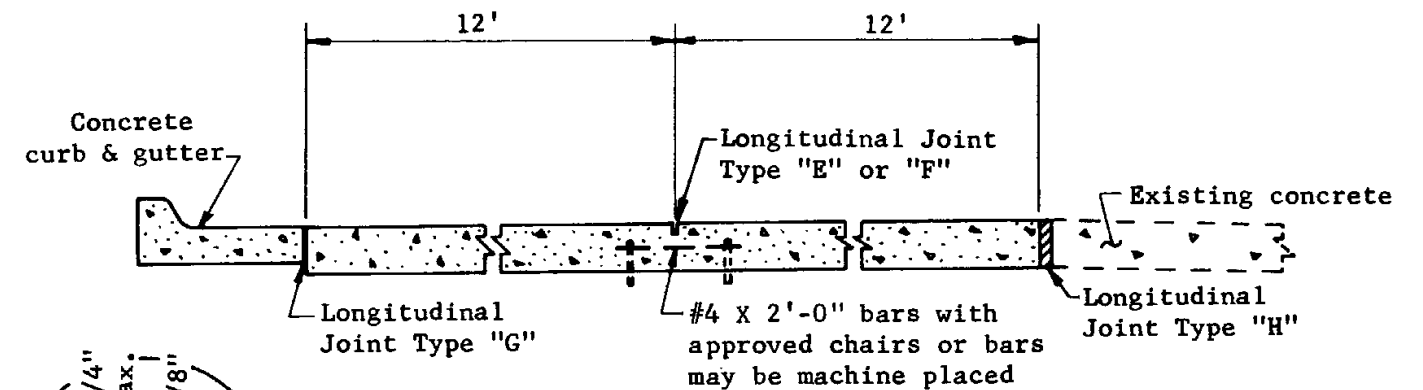
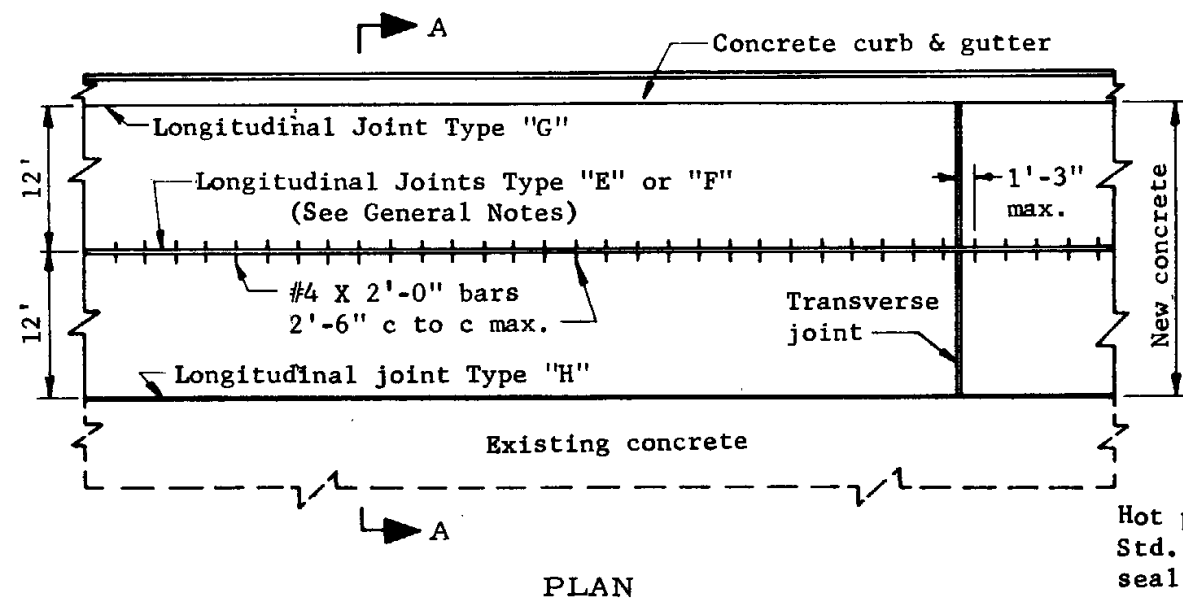
Timbers used in transverse expansion joint shall be rough redwood and conform to commercial grade.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

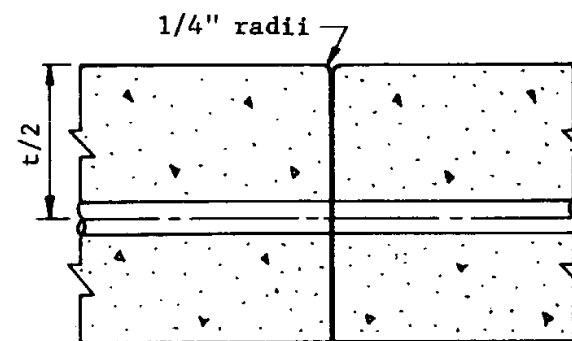
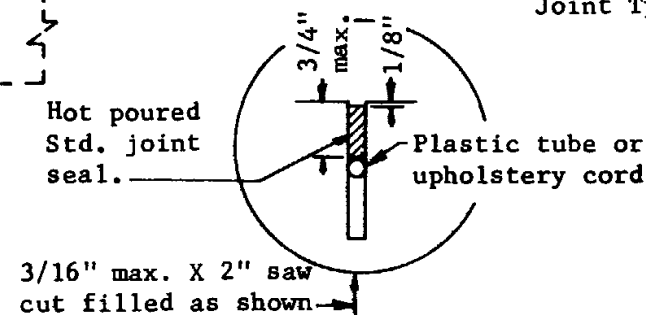
PORTLAND CEMENT
CONCRETE PAVEMENT
TRANSVERSE JOINTS

Drawn	L.O.M.	Drawing No. C-7.01
Traced	R.A.F. 12-66	
Checked	J.P.O. 870 5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

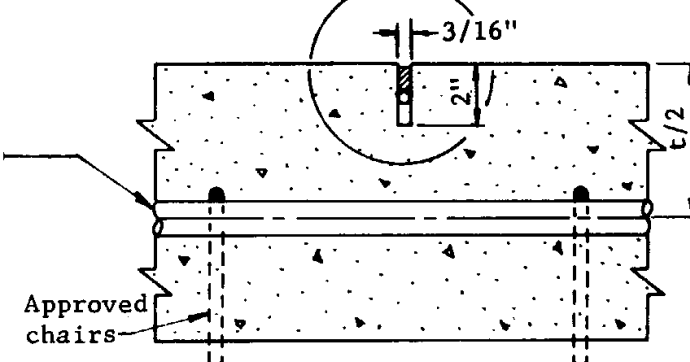


SECTION A-A

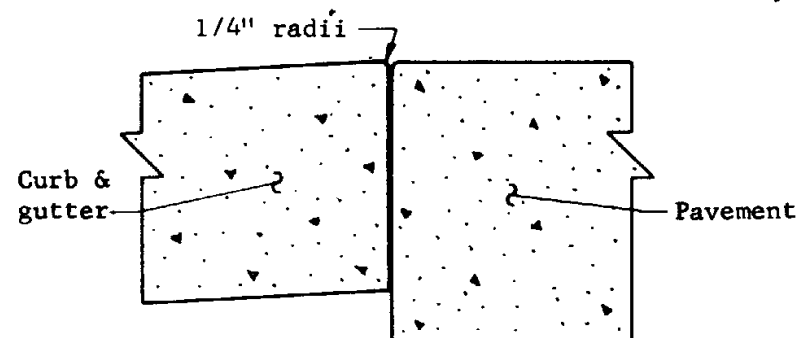


JOINT TYPE "E"

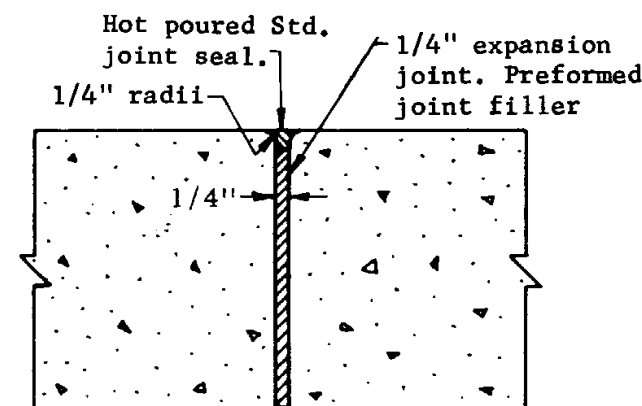
Note:
"t" indicates pavement thickness



JOINT TYPE "F"



JOINT TYPE "G"



JOINT TYPE "H"

LONGITUDINAL JOINT DETAILS

GENERAL NOTES

All bars used in joints shall be deformed. They shall be held securely in place, parallel to the subgrade and perpendicular to roadway centerline.

All formed longitudinal joints shall be finished with an edging tool not less than 1'-0" wide and 1'-6" long.

In slip form type pavement construction, Longitudinal Joint Type "F" shall be used. In fixed form type construction either Longitudinal Joint Type "E" or "F" may be used.

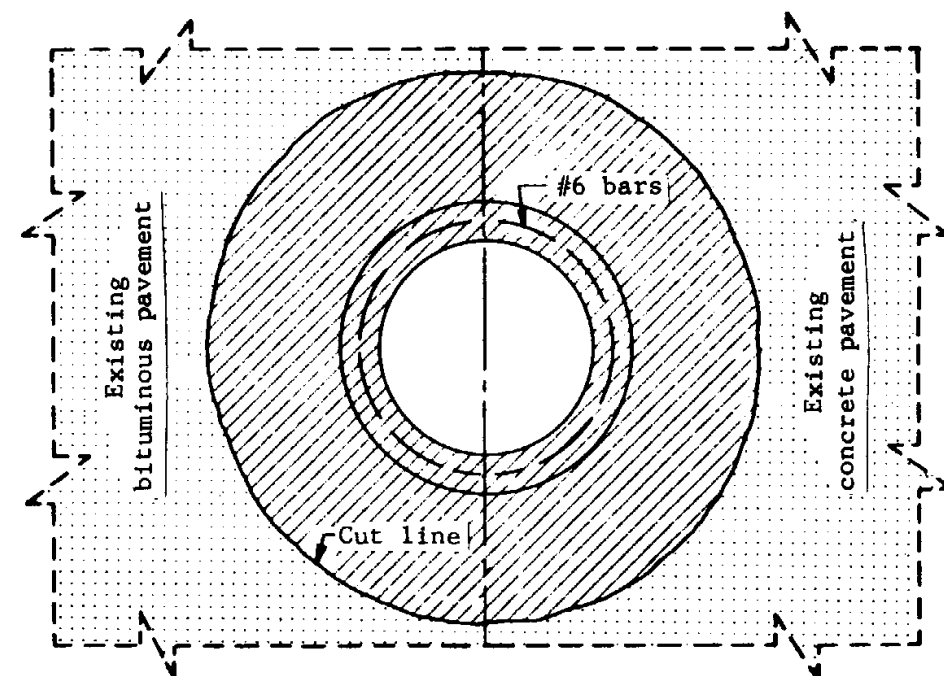
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

PORTLAND CEMENT
CONCRETE PAVEMENT
LONGITUDINAL JOINTS

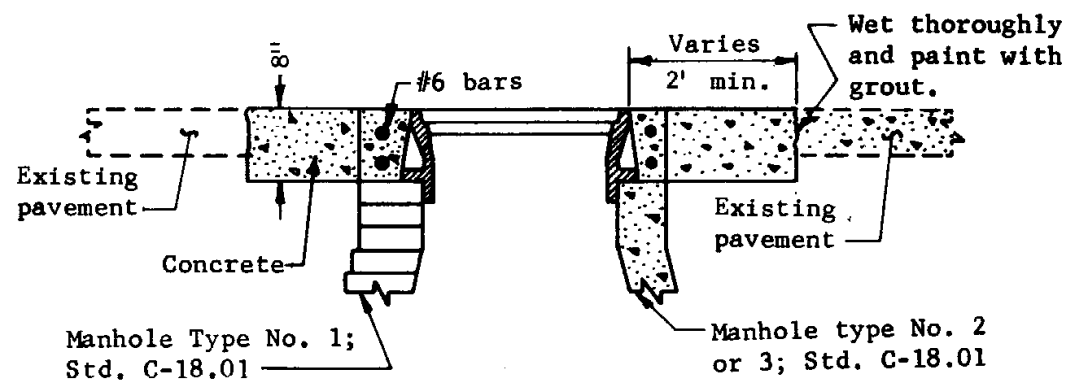
Drawn	O.K.
Traced	R.A.F. 12-66
Checked	J.P.O. 5-68
Approved Engr. Plans	5-68

Drawing No.
C-7.02

Rev

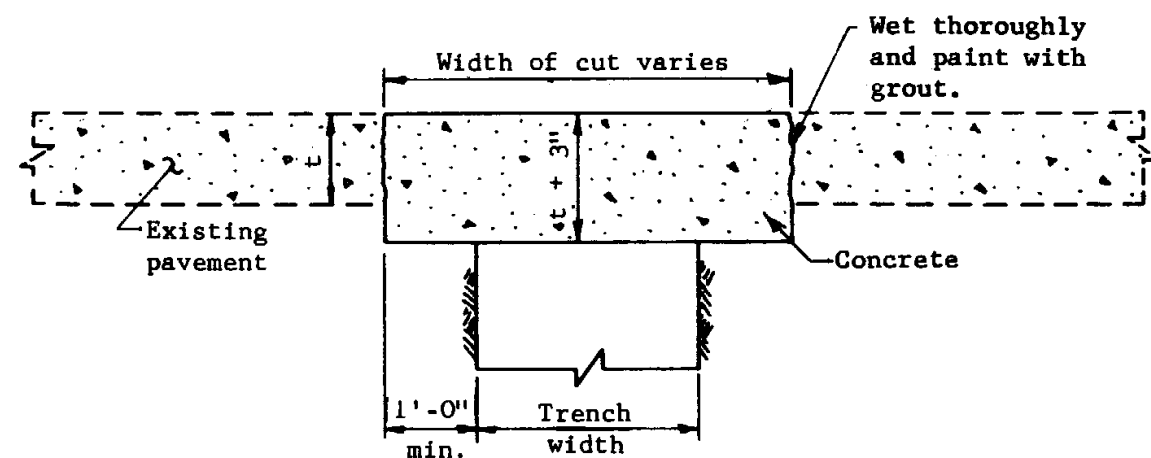


PLAN

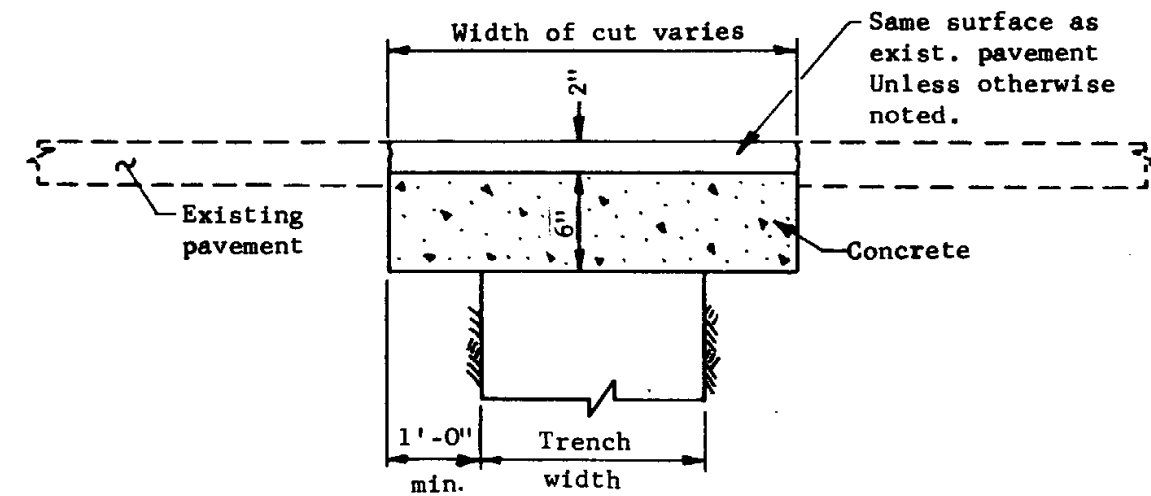


SECTION

PAVEMENT CUT REPLACEMENT FOR MANHOLE



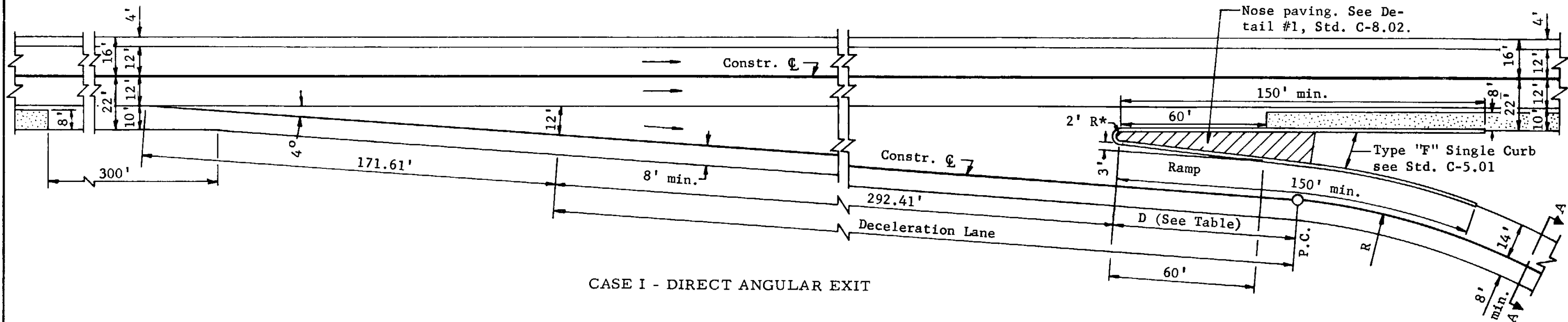
CUT IN CONCRETE PAVEMENT



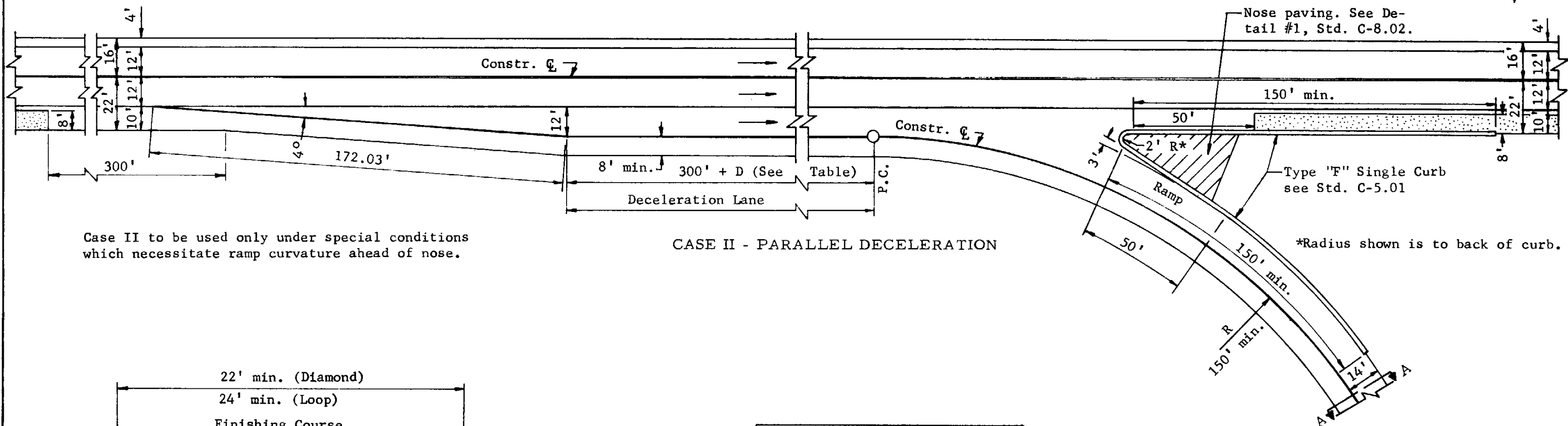
CUT IN BITUMINOUS PAVEMENT

GENERAL NOTES
All concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
PAVEMENT CUT REPLACEMENT			
Drawn	O.K.	Drawing No. C-7.03	
Traced	R.A.F. 12-5-66		
Checked	J.P.O. 9/10 5-68		
Approved Engr. Plans	W.H.H. 5-68		



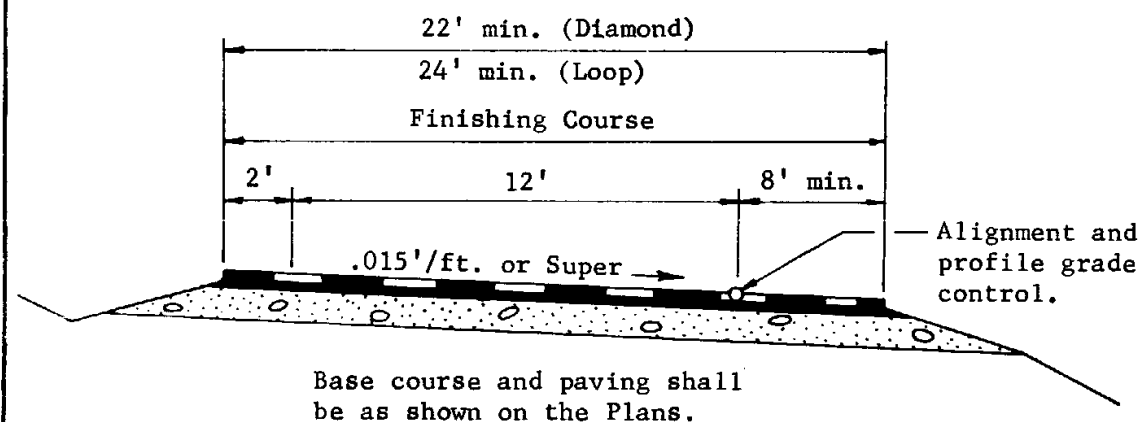
CASE I - DIRECT ANGULAR EXIT



Case II to be used only under special conditions which necessitate ramp curvature ahead of nose.

CASE II - PARALLEL DECELERATION

*Radius shown is to back of curb.



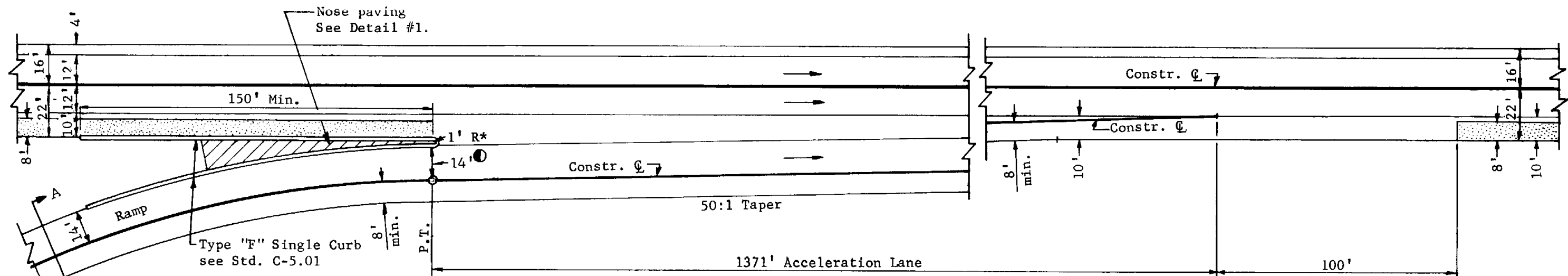
SECTION A-A

R (Feet)	Min. D (Feet)
Less than 250'	275'
250' - 450'	200'
450' - 1000'	100'
Over 1000'	60'

GENERAL NOTES

Ramp take off from main curved roadway should provide equivalent minimum deceleration control distances. Shaded areas indicate differential shoulder delineation. See Pavement Marking Standards for stripe details.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
TYPICAL EXIT RAMP TERMINALS			
Drawn	C.B.	3-60	Drawing No. C-8.01
Traced	S.L.T.	8-67	
Checked	J.P.O.	<i>SPD 5-68</i>	
Approved Engr. Plans	<i>W. Heidecker 5-68</i>		



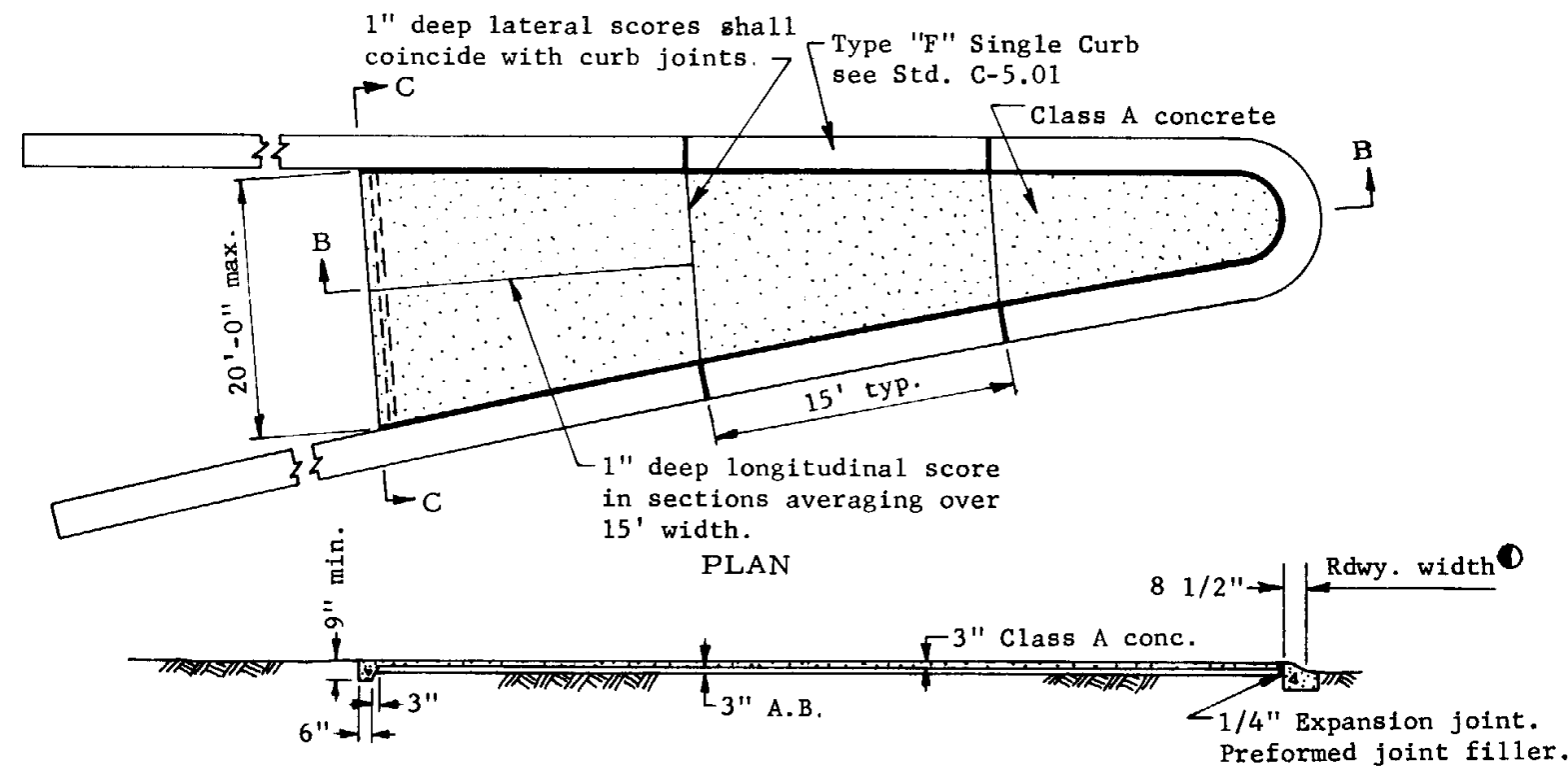
*Radius shown is to back of curb.

GENERAL NOTES

The 50:1 taper and corresponding offsets shall also apply when the main roadway has curvature or combined tangent and curvature.

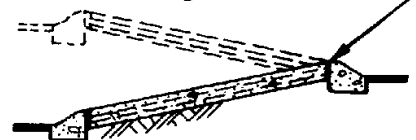
Shaded areas indicate differential shoulder delineation.

See Pavement Marking Standards for stripe details.



SECTION B-B

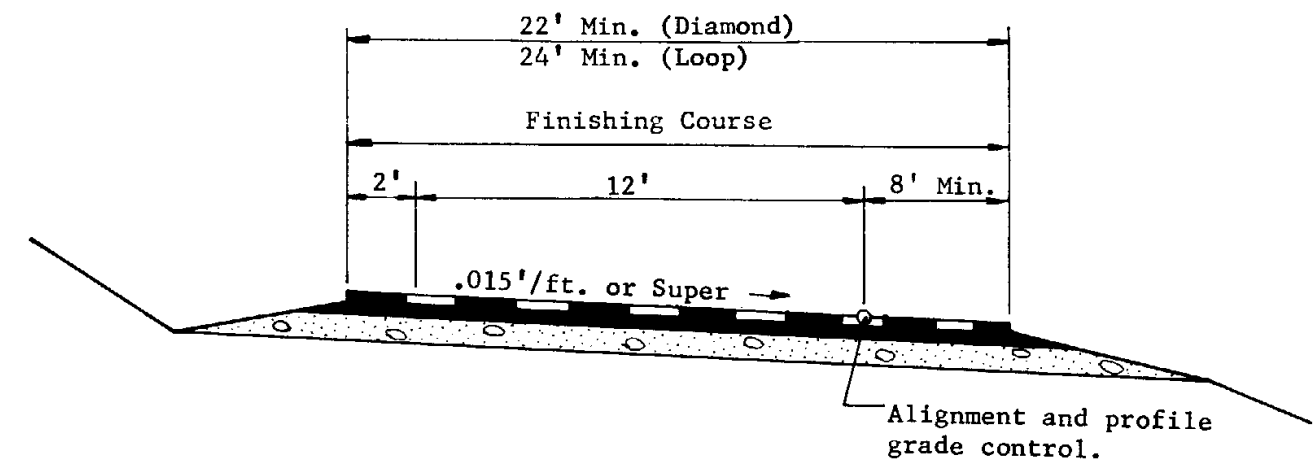
1/4" Expansion joint.
Preformed joint filler.



SECTION C-C

DETAIL #1 - NOSE PAVING

NOTE: All joints and scores shall be edged with a 1/4" radius tool.
Extend nose paving to a 20' max. width or 30' in length measured from the nose, but in no case shall the paving extend beyond curb end.



SECTION A-A

Base course and paving shall be as shown on the plans.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

TYPICAL ENTRANCE RAMP TERMINAL

Drawn	C.B. 3-60
Traced	S.L.T. 8-67
Checked	J.P.O. 9PD 5-68
Approved Engr. Plans	W.H. 5-68

Drawing No.

C-8.02

Rev

The M8-1 delineator is used as a guide marker for through roadway alignment, and is placed as follows:

1. For interstate roadways and other roadways that meet freeway standards, the M8-1 delineators are placed continuously on the right side except where fixed source lighting is in operation and where left-side placement is necessary to clearly show the alignment.
2. For roadways that do not meet freeway standards, the M8-1 delineators are placed continuously on the right side except (a) where fixed source lighting is in operation, (b) along areas used for pull-offs or parking, or (c) on hazardous right-hand curves where the delineators are placed on the left. Delineators are bi-directional when applied on the left side of hazardous right-hand curves on two-way roadways.
3. M8-1 delineators are placed on through roadways at interchanges regardless of fixed source lighting. The crossroad through an interchange is normally delineated within the limits of the right-of-way at rural interchanges and grade separations.
4. When an M8-1 delineator falls within a crossroad, driveway, parking area, etc., it is moved in either direction a distance not to exceed one quarter of the normal spacing. If proper placement still cannot be obtained, the delineator is eliminated. M8-1 delineators are not located closer than one-quarter of the normal spacing before or beyond a hazard marker or milepost marker.



M8-1

The M8-2 delineator is used as a guide marker for the alignment of acceleration and deceleration lanes and for entrance and exit ramps. It is used at all interchanges regardless of fixed source lighting and is placed as follows:

1. The M8-2 delineators are placed continuously on the right side of tangent and left-curving ramps and speed-change lanes. On right-hand curves they are placed on the left side.
2. On curves, the delineator spacing may be adjusted slightly so that a delineator falls on the P. C. and P. T. of the curve.



M8-2



M9-1L



M9-1R

The M9-1 bridge marker is used to mark the ends of narrow bridges. The marker is placed on each side of both ends of bridges located on two-way roadways, and on each side of the approach end of bridges located on one-way roadways.



M9-2

The M9-2 pipe culvert marker may be used to mark the ends of pipes which require periodic maintenance except that they are not installed in the medians of divided highways.



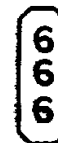
M9-3H

The M9-3H hazard marker is used to mark obstructions that are located within the roadway, such as exit terminal noses and channelization islands.



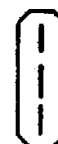
M9-3V

The M9-3V hazard marker is mounted on or immediately in front of obstructions that are located within 2 feet of the pavement edge. These markers are not placed behind guardrail or embankment curb or within a line of M8-2 delineators.



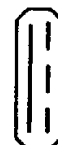
M9-5

The M9-5 milepost marker is placed on the right side of the roadway. If it cannot be placed within 0.01 mile accuracy, it is omitted.



M9-6(1)

The M9-6(1) striping marker is used to mark the end of no-passing zones.



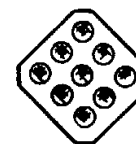
M9-6(2)

The M9-6(2) striping marker is used to mark the beginning of pavement striping at no-passing zones in effect for one direction of travel only.



M9-6(3)

The M9-6(3) striping marker is used to mark the beginning of pavement striping at no-passing zones in effect for both directions of travel.



M9-9

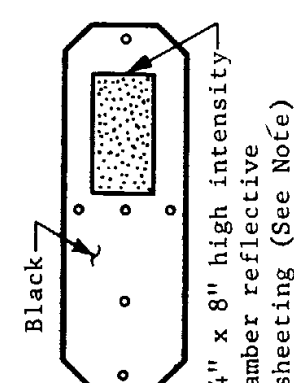
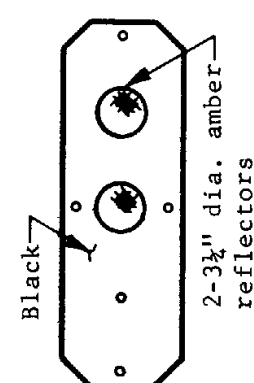
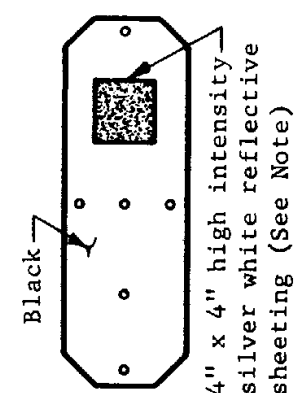
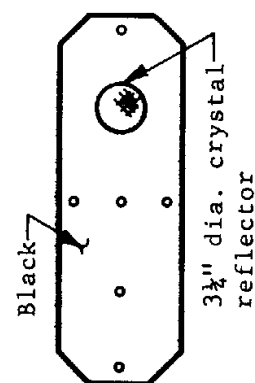
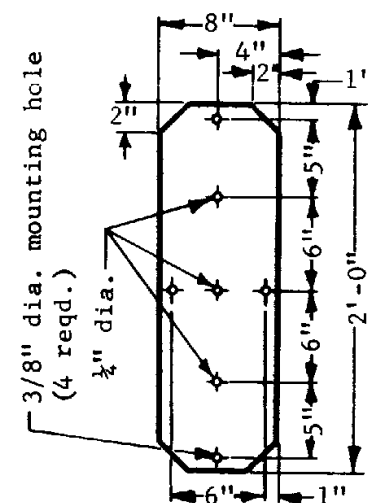
The M9-9 hazard marker is used to mark extreme hazards located within the roadway, such as transitions from two-way roadways to divided roadways, or at dead-end locations.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

Rev

DELINEATOR USAGE

Drawn	T.E.D. 4-68	Drawing No. C-9.01
Traced	T.E.D. 4-68	
Checked	J.P.O. <i>JPO 4-68</i>	
Approved Engr. Plans	<i>H. Heidecker 4-68</i>	



NOTES :

All delineator plates, hazard-marker plates, milepost plates, striping-marker plates, and pipe-culvert marker plates shall be constructed from either 16 ga. steel or 6061-T6-.063 aluminum sheet. The M9-1R and M9-1L hazard marker plates may be constructed from sign-grade plywood.

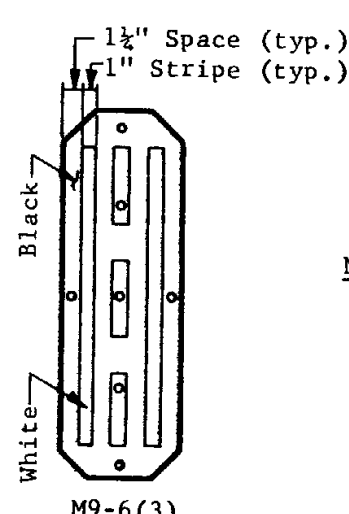
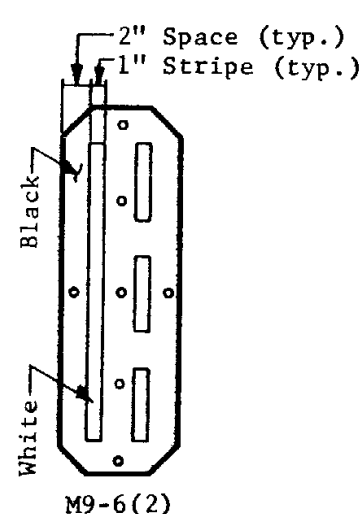
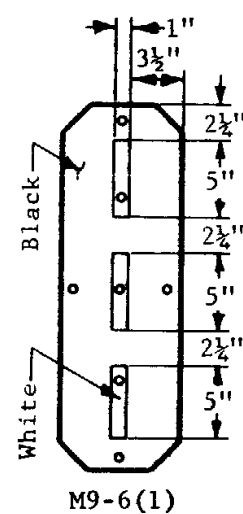
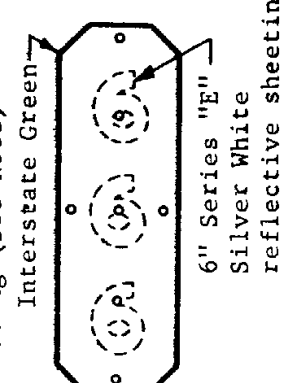
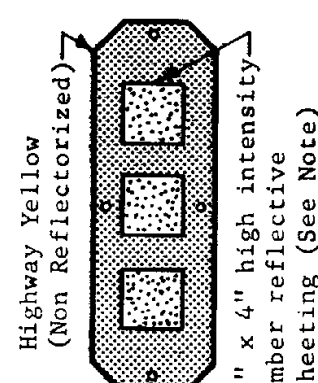
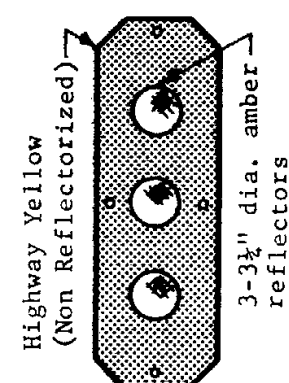
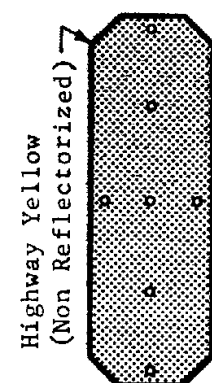
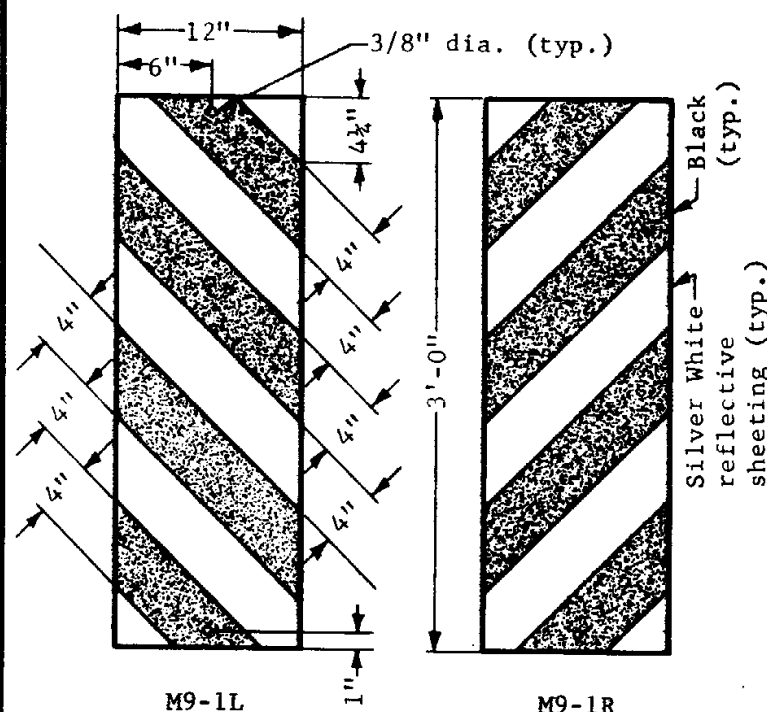
The 16 ga. steel plates shall be painted with one coat of 1A or 1B primer, both sides, and one coat of industrial synthetic black, Interstate green, or highway yellow enamel, both sides, as specified, or shall be a minimum spangle hot-dipped galvanized, Federal Spec. QQ-S-775A and primed with a corrosion inhibiting primer and final coat black, Interstate green, or highway yellow enamel Federal Spec. TT-E-489C Class B or equal.

The 6061-T6 aluminum sheets shall be etched by approved methods and then primed with 1D primer, both sides. Final coat, both sides, shall be industrial synthetic black, Interstate green, or highway yellow as specified.

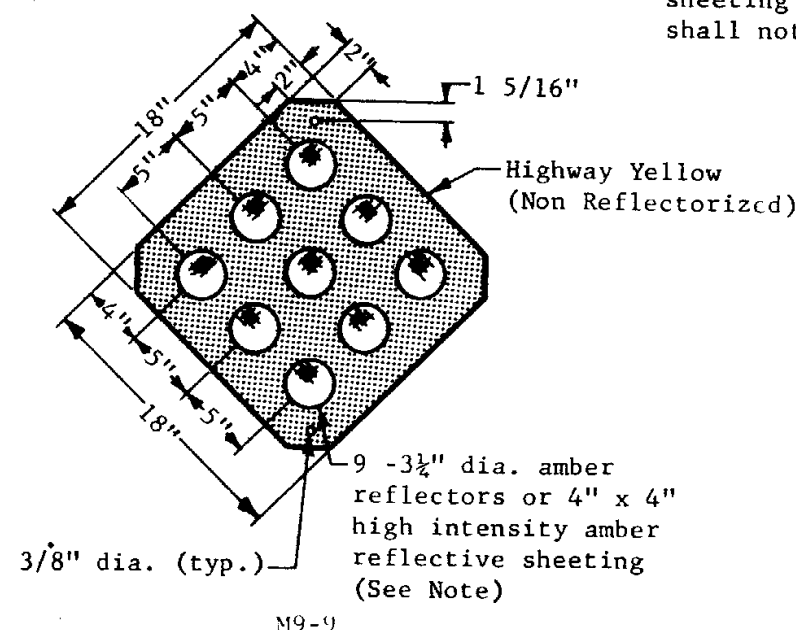
Stripes for the striping markers shall be painted with industrial synthetic white enamel paint conforming to Federal Spec. TT-E-489C Class B or equal.

Amber and crystal reflectors shall be plastic, prismatic, center-mounted devices mounted with 3/16" dia. corrosion resistant fasteners, or high-intensity, weather-resistant reflective sheeting applied directly to the back plate. Reflective sheeting for M9-1 hazard markers shall be silver-white, weather-resistant reflective sheeting. All reflective devices shall conform to the A.H.D. Standard Specifications.

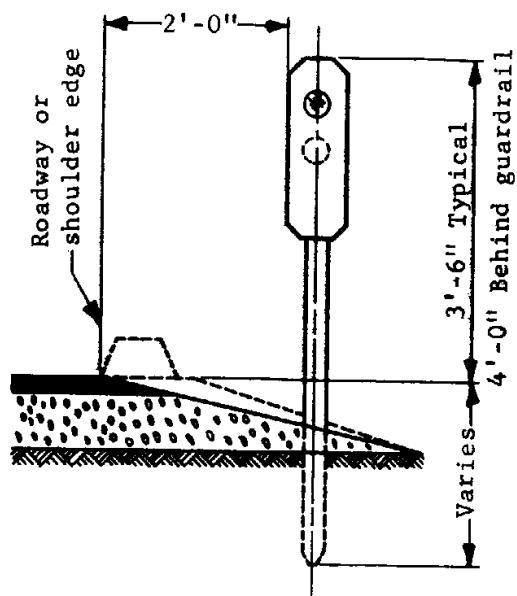
Where back plates are furnished with the reflective sheeting type reflector, the reflector mounting holes shall not be provided.



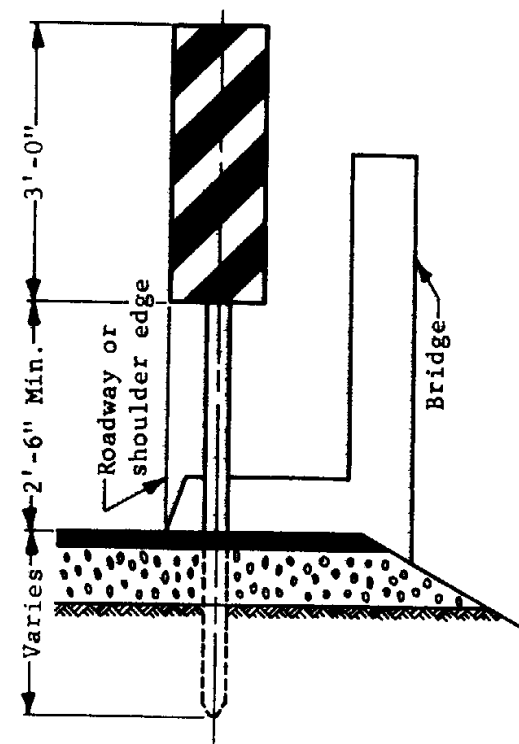
NO SCALE



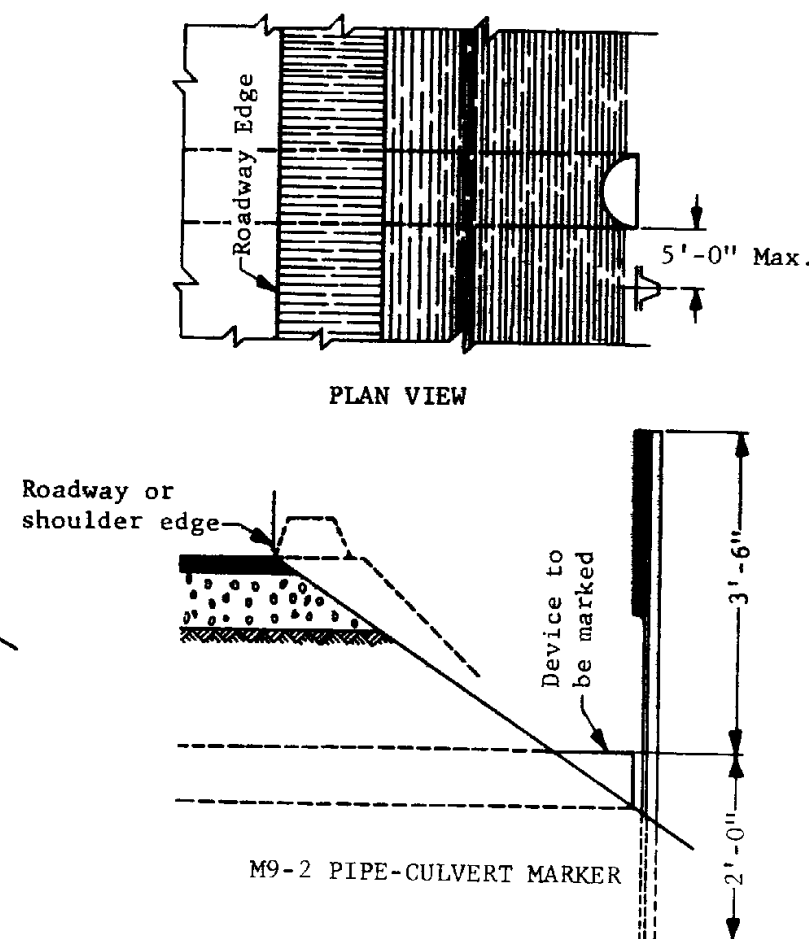
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
<div style="text-align: center;"> <h1>DELINEATOR FACE PLATE DETAILS</h1> </div>		
Drawn	T.E.D. 4-68	Drawing No. <h2>C-9.02</h2>
Traced	T.E.D. 4-68	
Checked	J.P.O. <i>JPO 4-68</i>	
Approved Engr. Plans	<i>E. Heidecker 4-68</i>	



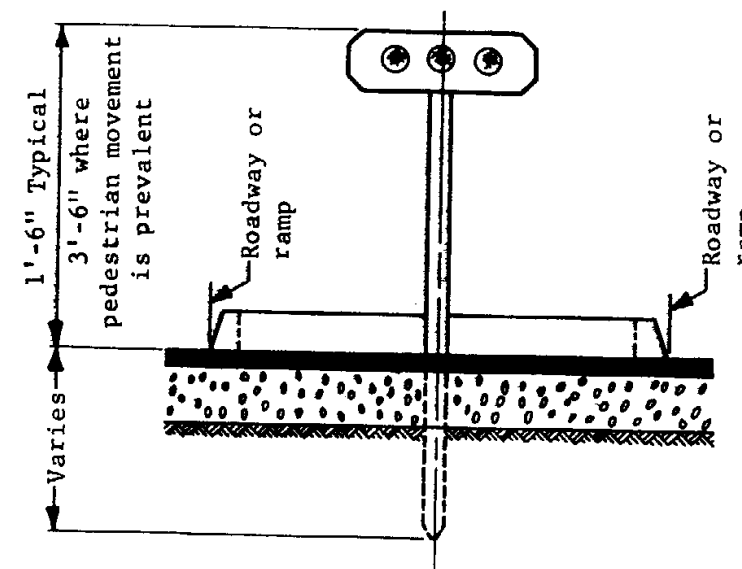
M8-1 AND M8-2 DELINEATORS



M9-1 HAZARD MARKER



M9-2 PIPE-CULVERT MARKER



M9-3H HAZARD MARKER

NOTES:

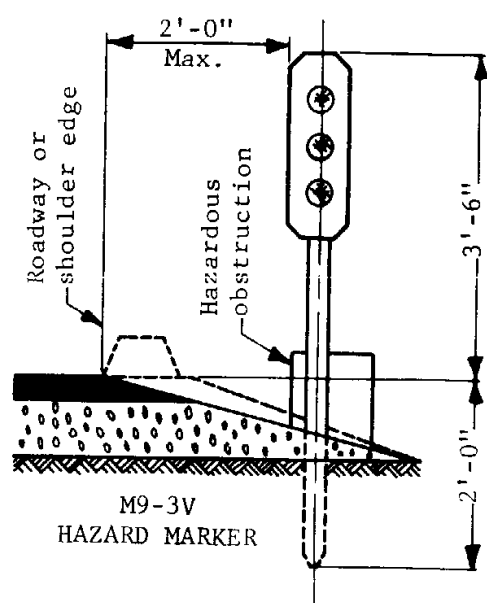
Delineator, hazard-marker and mile-post plates are installed perpendicular to the roadway.

Pipe-culvert marker and striping-marker plates are oriented parallel to the roadway.

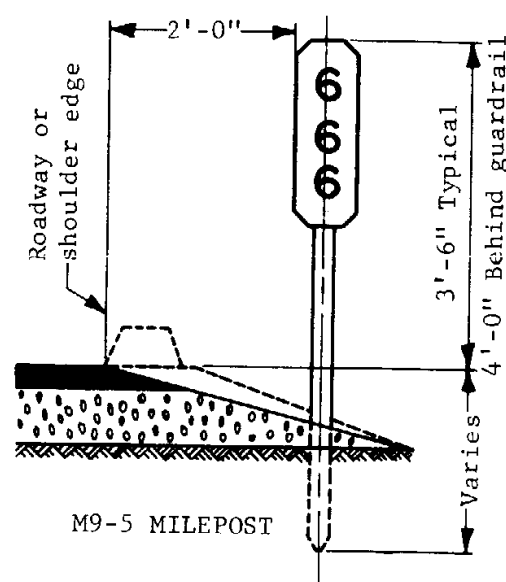
Striping markers are placed as far as practicable from the roadway edge.

The inside edge of M9-3V, M9-1L and M9-1R hazard markers is placed in line with the inside edge of the obstruction.

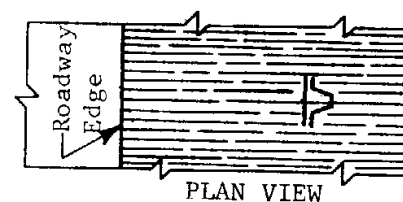
NO SCALE



M9-3V
HAZARD MARKER

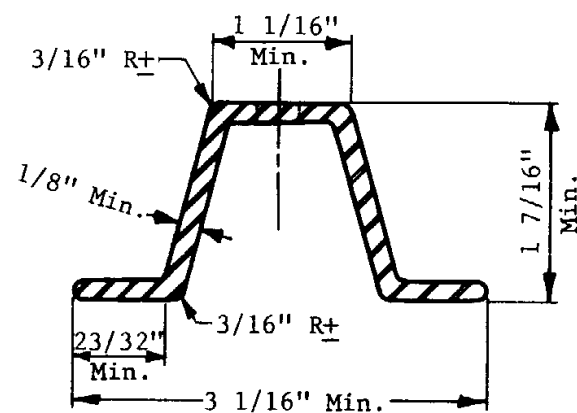
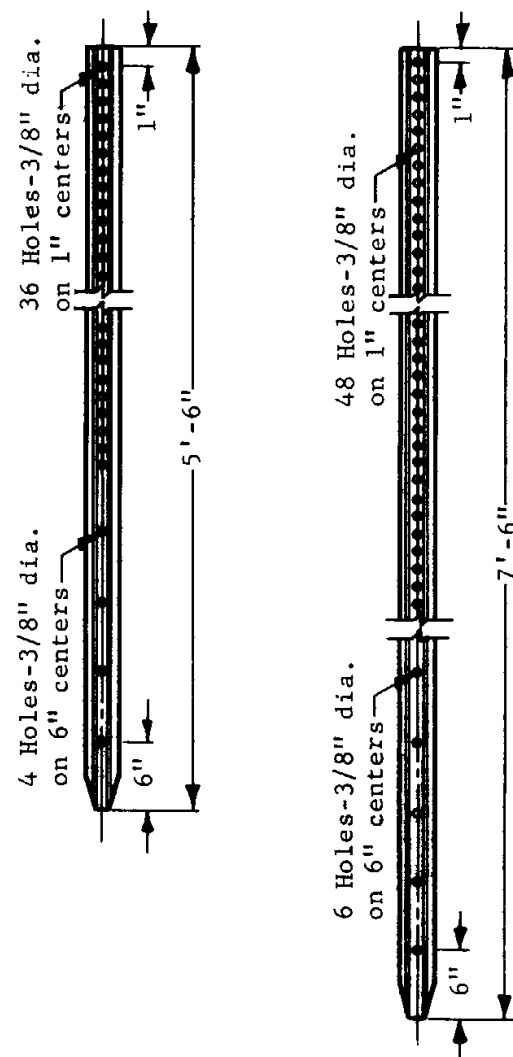


M9-5 MILEPOST

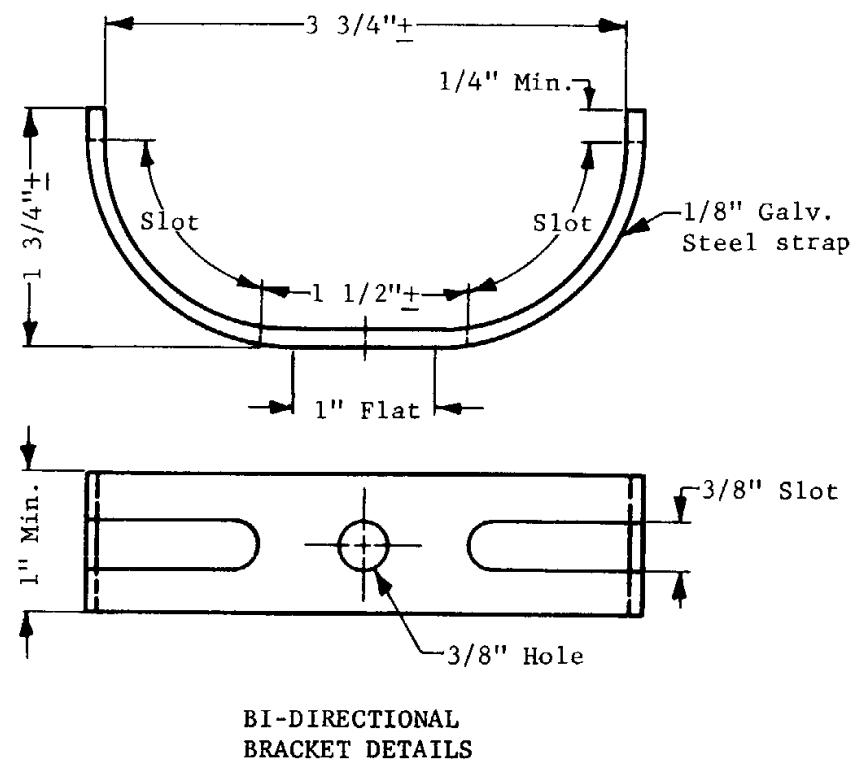
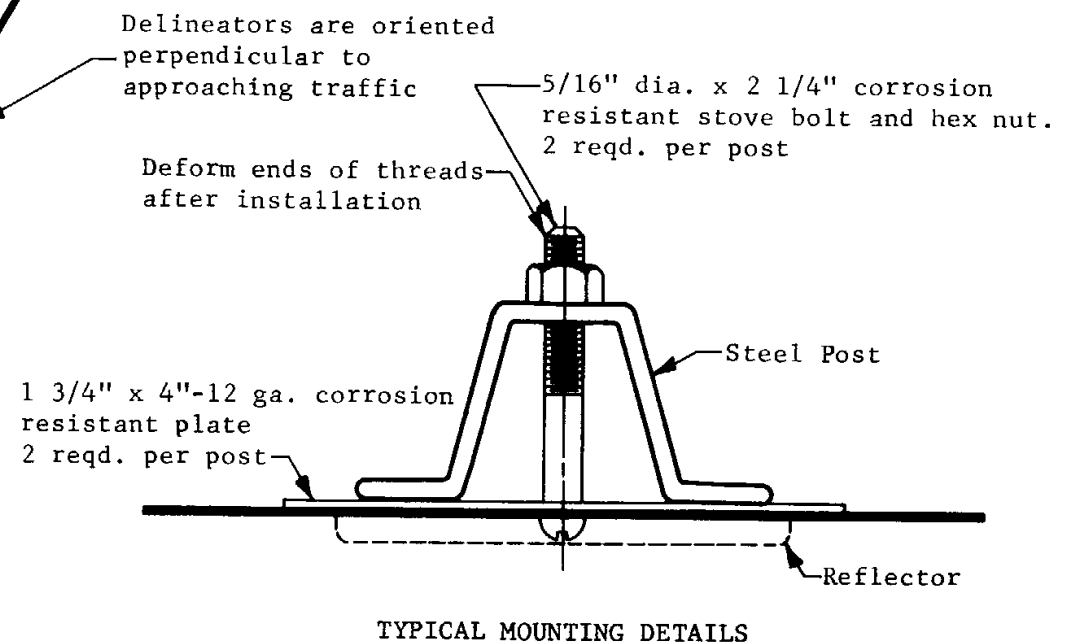
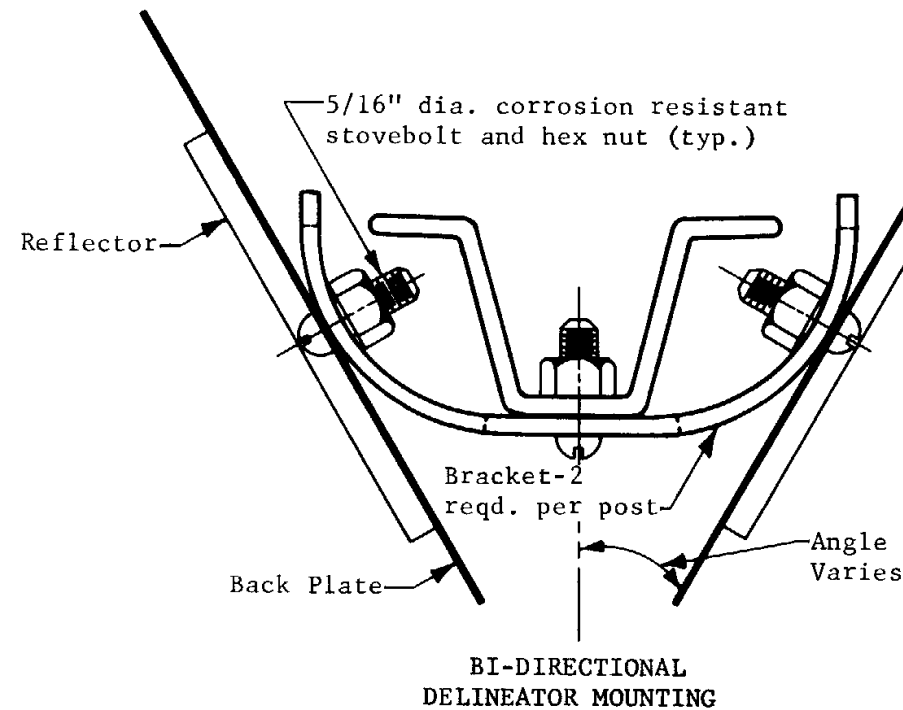


M9-6 STRIPING MARKER

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
DELINEATOR PLACEMENT			
Drawn	T.E.D. 4-68	Drawing No. C-9.03	
Traced	T.E.D. 4-68		
Checked	J.P.O. 9PO 4-68		
Approved Engr. Plans	<i>J. Hildebrand</i> 4-68		



STEEL POSTS



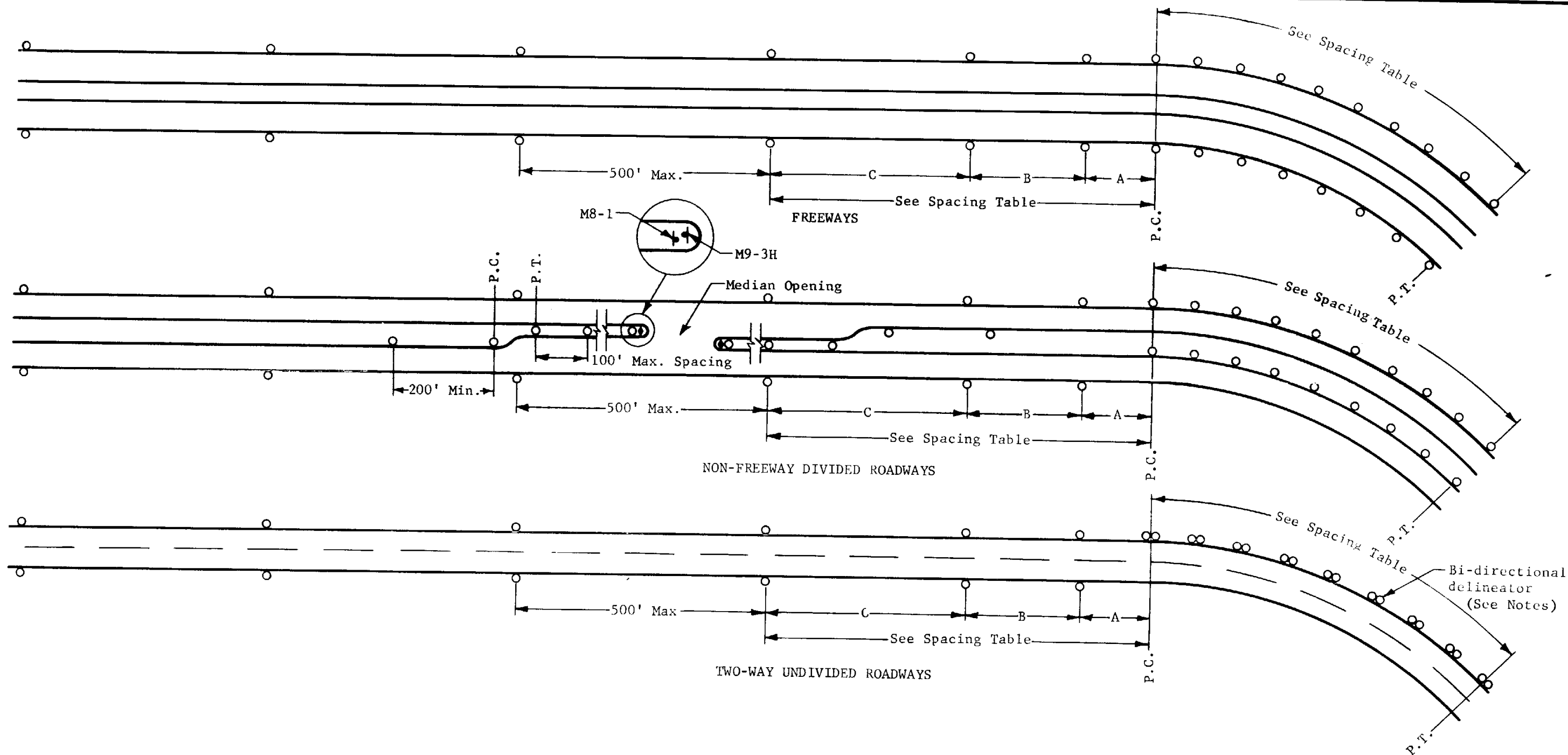
NO SCALE

NOTES:

Steel posts shall conform to ASTM-A-499 and shall not weigh less than 1.9 lbs. per foot.

Steel posts and bi-directional delineator bracket shall be galvanized to conform to ASTM-A-123.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
DELINEATOR POST AND MOUNTING DETAILS			
Drawn	T.E.D. 4-68	Drawing No. C-9.04	
Traced	T.E.D. 4-68		
Checked	J.P.O. <i>JPO 4-68</i>		
Approved Engr. Plans	<i>R. Heideker 4-68</i>		



NOTES:

1. M8-1 delineators are placed on the left side at hazardous right-turning curves on two-way undivided and non-freeway divided roads. They are bi-directional, visible from opposite directions, only on two-way undivided roadways.
2. The M8-1 and M9-3H markers at median openings with left-turn lanes may be mounted together on a single post when terminal width is 4'-0" or less.
3. Undivided two-way roadways having four or more traffic lanes should be delineated continuously on both sides.

NO SCALE

LEGEND

- M8-1
- ◆ M9-3H

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

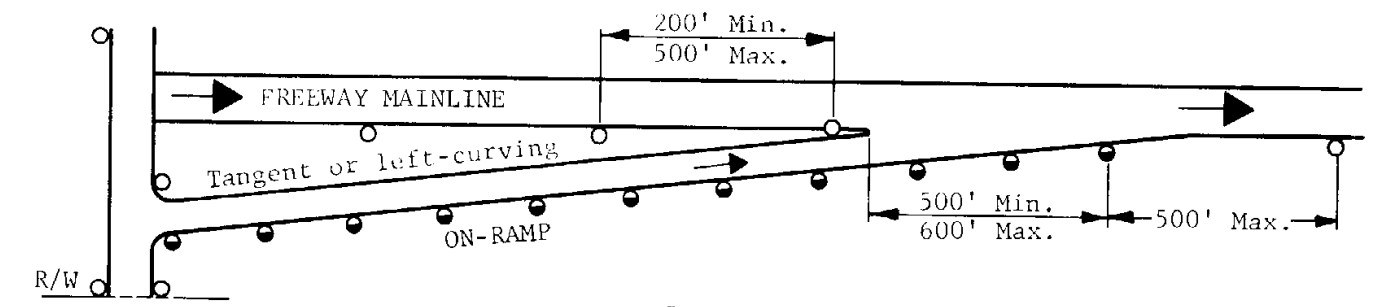
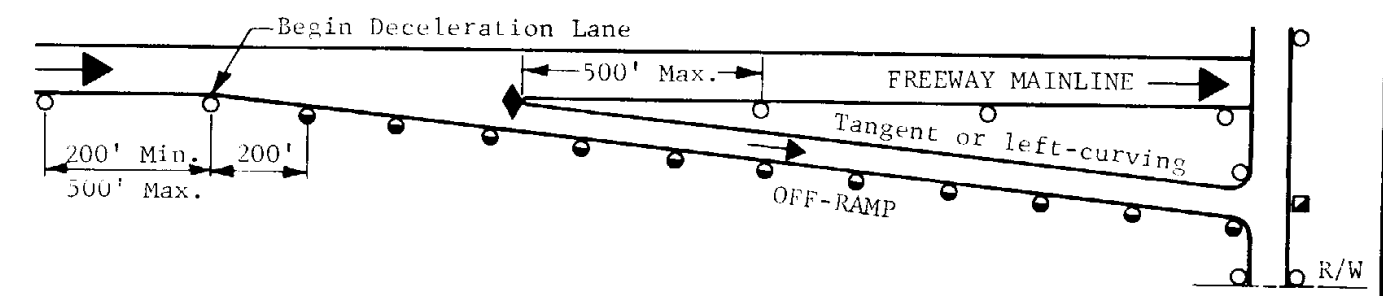
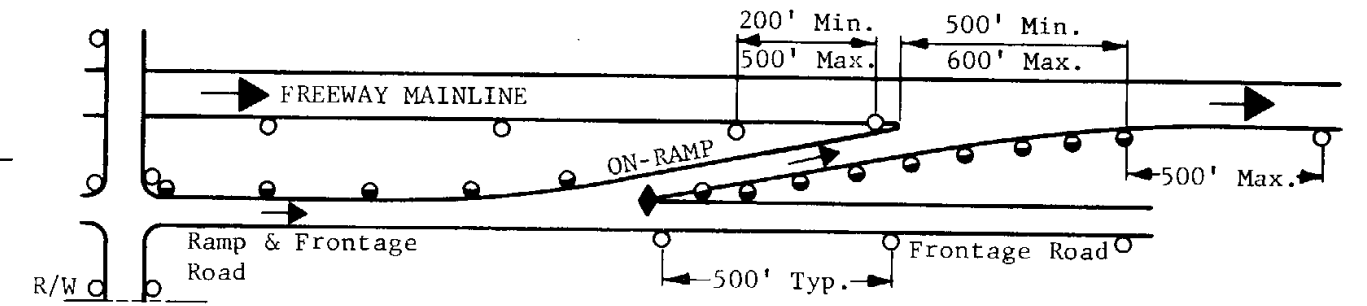
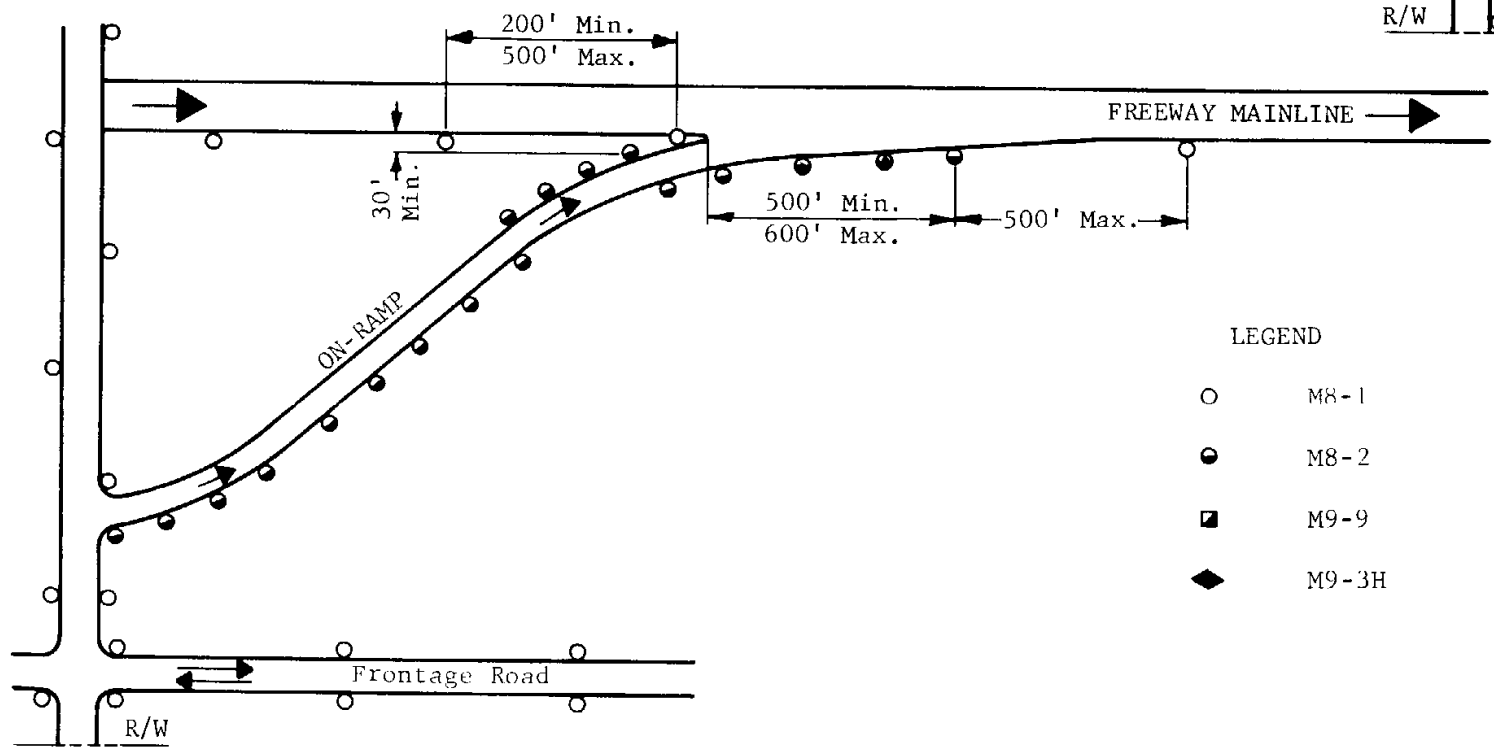
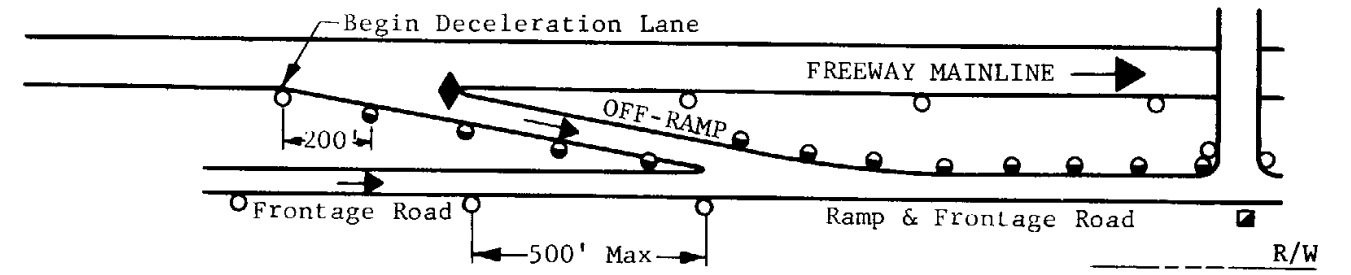
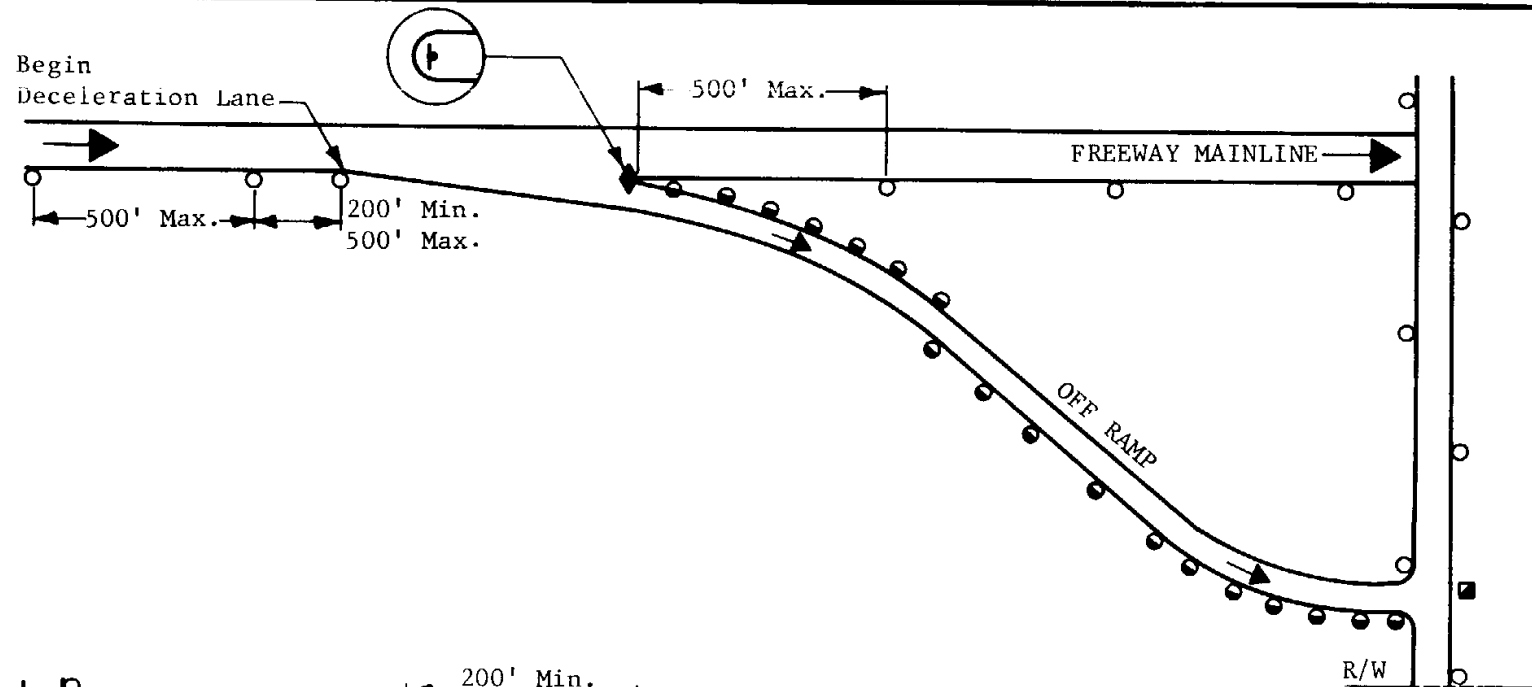
DELINEATOR MAINLINE SPACING

Drawn	T.E.D. 4-68
Traced	T.E.D. 4-68
Checked	J.P.O. <i>JPO 4-68</i>
Approved Engr. Plans	<i>H. Heideck 4-68</i>

Drawing No.

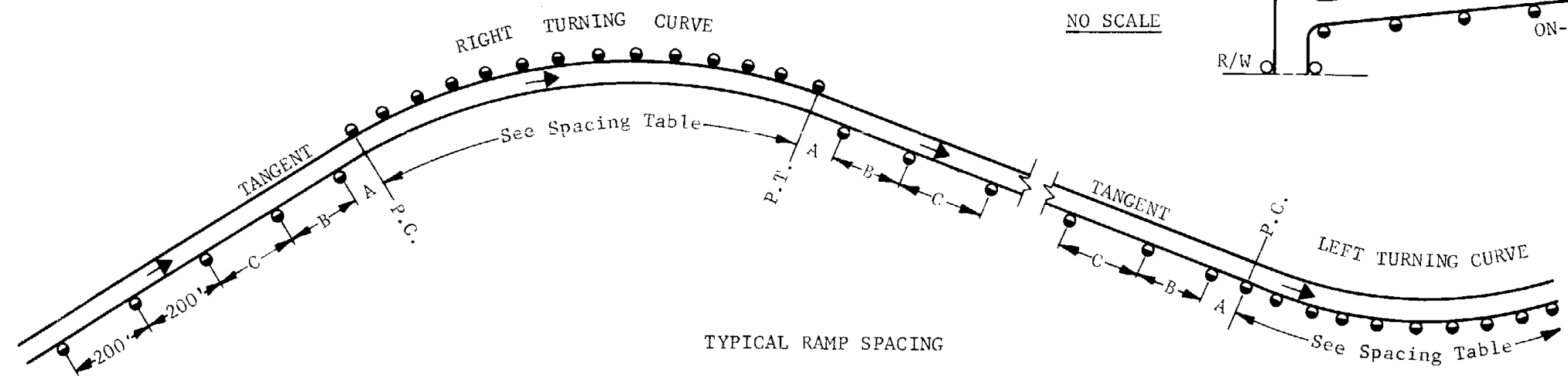
C-9.05

Rev



- LEGEND
- M8-1
 - M8-2
 - M9-9
 - ◆ M9-3H

NO SCALE

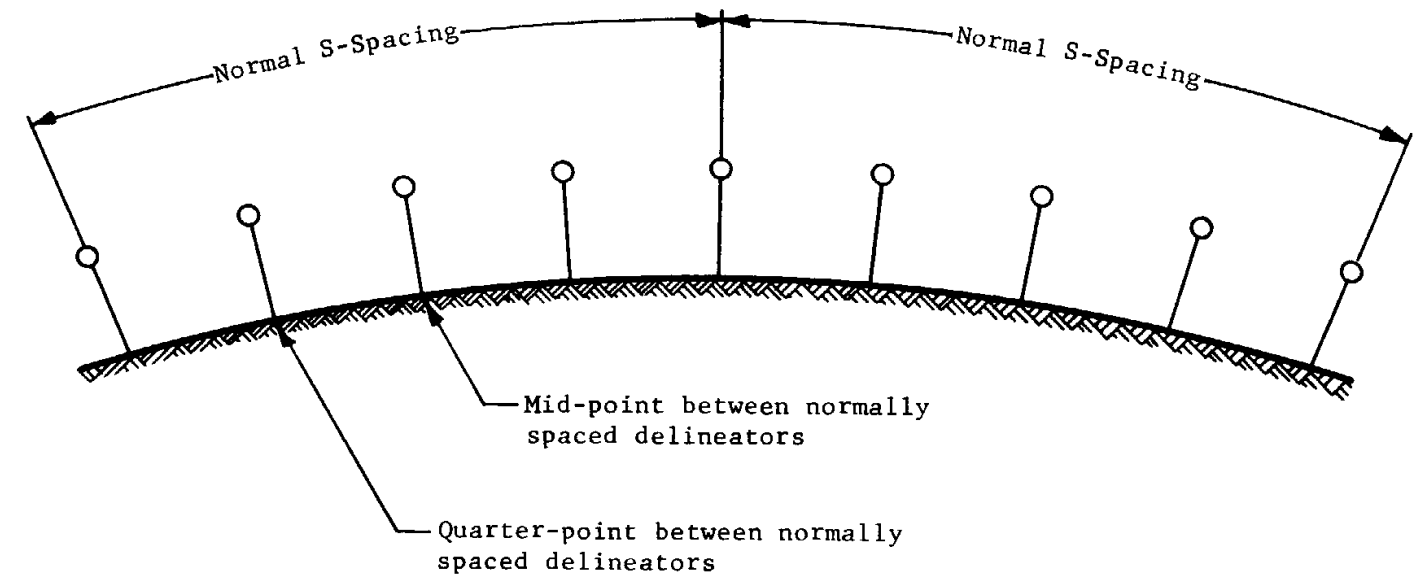


ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
DELINEATOR INTERCHANGE SPACING			
Drawn	T.E.D. 4-68	Drawing No. C-9.06	
Traced	T.E.D. 4-68		
Checked	J.P.O. <i>JPO</i> 4-68		
Approved Engr. Plans	<i>Heiderker</i> 4-68		

SPACING TABLE

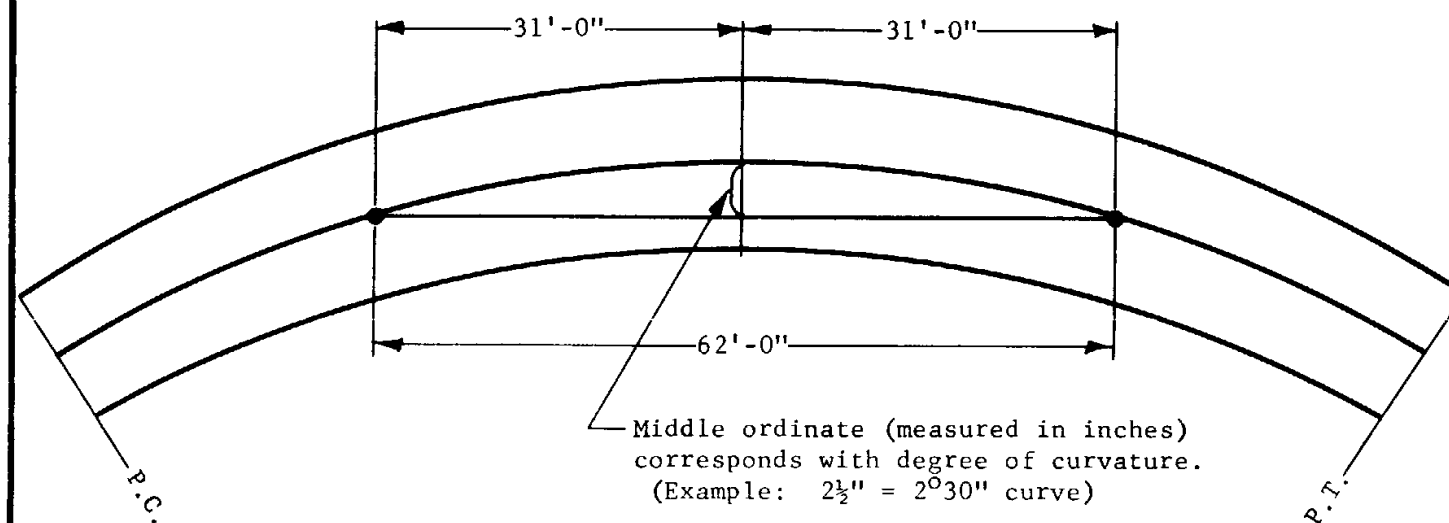
Degree of Curve	Spacing on Curve in feet (S)	Space in Advance and Beyond Curve in Feet		
		A	B	C
0°-0' to 0°-30'	500	500	500	500
0°-45'	450	500	500	500
1°-0'	400	500	500	500
1°-15'	350	500	500	500
1°-30'	300	500	500	500
1°-45'	250	450	500	500
2°-0'	200	360	500	500
3°-0' to 5°-0'	150	270	450	500
6°-0' to 10°-0'	100	180	300	500
11°-0' to 17°-0'	75	135	225	450
18°-0' to 34°-0'	50	90	150	300
35°-0' and Greater	25	45	75	150

Important: Maximum spacing for M8-2 delineators is 200 feet (broken line).
Maximum mainline spacing for M8-1 delineators is 500 feet.
Necessary field adjustments in spacing length shall be made by the Engineer.



SPACING PROCEDURE FOR HORIZONTAL AND (CREST)
VERTICAL CURVES
(Vertical Curve Shown)

The following method may be used to estimate the degree of curvature when insufficient data is available.



To Determine Spacing By This Method

Find degree of curvature by stretching a 62'-0" line at any convenient point on the centerline of the curve and then measure the middle ordinate (in inches). The middle ordinate corresponds with the degree of curvature.

NOTE:

There shall be a minimum of 3 delineators continuously visible on horizontal curves and the crest of vertical curves. When 3 delineators are not visible, install additional delineators at the midpoints between the normally spaced delineators. If 3 delineators are still not visible, install additional delineators at the quarter points or smaller even increments between the normally spaced delineators until 3 delineators become continuously visible.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

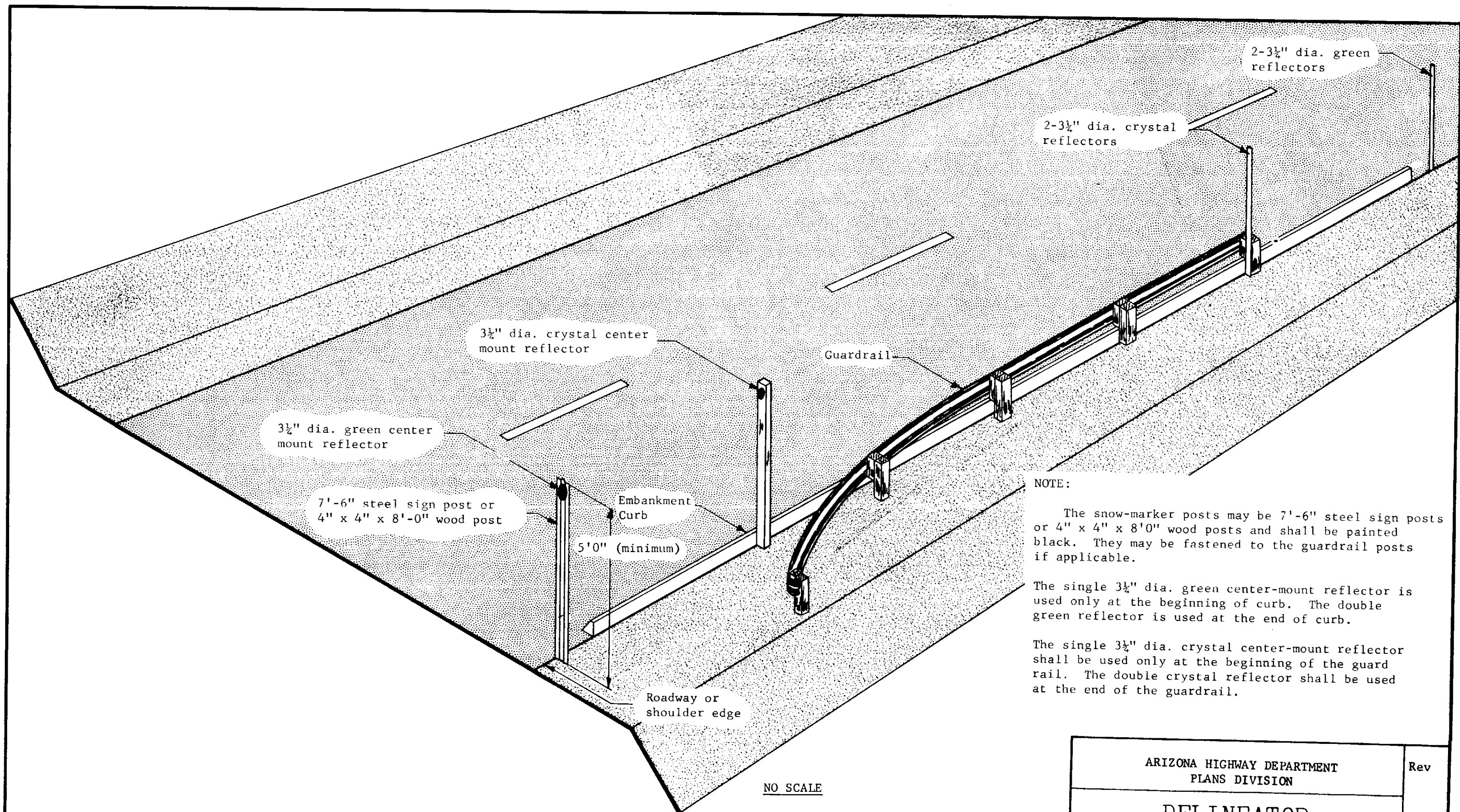
Rev

DELINEATOR SPACING TABLE

Drawn	T.E.D. 4-68
Traced	T.E.D. 4-68
Checked	J.P.O. JPD 4-68
Approved	
Engr. Plans	S. Heidecker, A.S.C.

Drawing No.

C-9.07



NOTE:

The snow-marker posts may be 7'-6" steel sign posts or 4" x 4" x 8'-0" wood posts and shall be painted black. They may be fastened to the guardrail posts if applicable.

The single 3 1/2" dia. green center-mount reflector is used only at the beginning of curb. The double green reflector is used at the end of curb.

The single 3 1/2" dia. crystal center-mount reflector shall be used only at the beginning of the guard rail. The double crystal reflector shall be used at the end of the guardrail.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

Rev

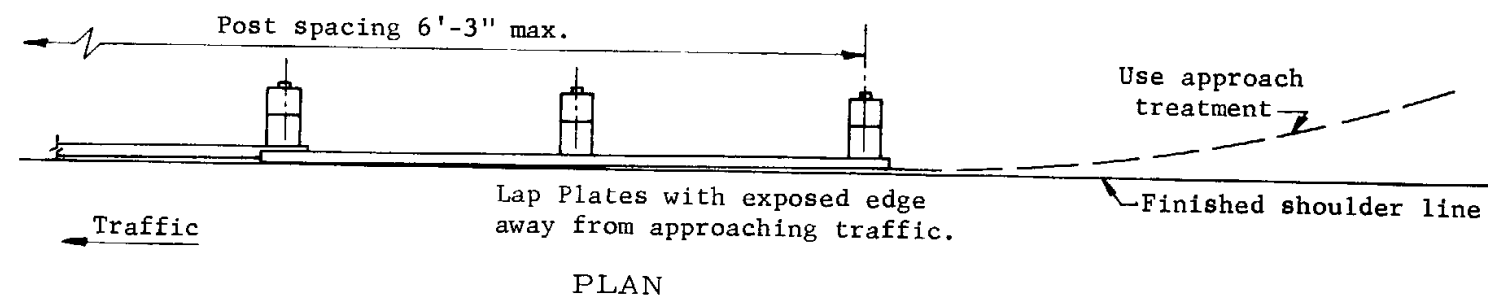
DELINEATOR
SNOW MARKER

Drawn	T.E.D. 4-68
Traced	T.E.D. 4-68
Checked	J.P.O. <i>JPO 4-68</i>
Approved Engr. Plans	<i>J. Heidrich 4-68</i>

Drawing No.

C-9.08

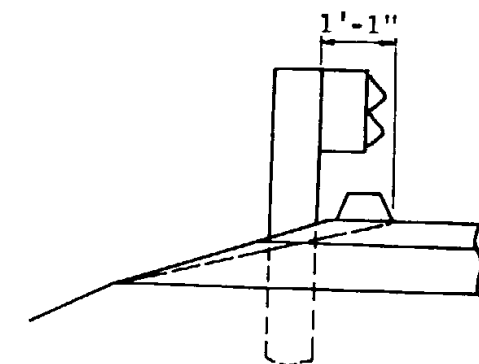
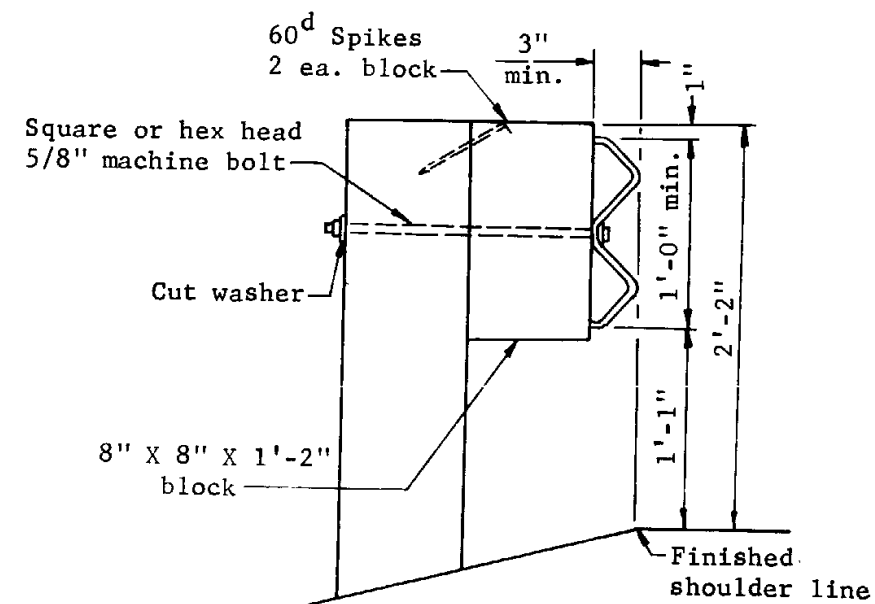
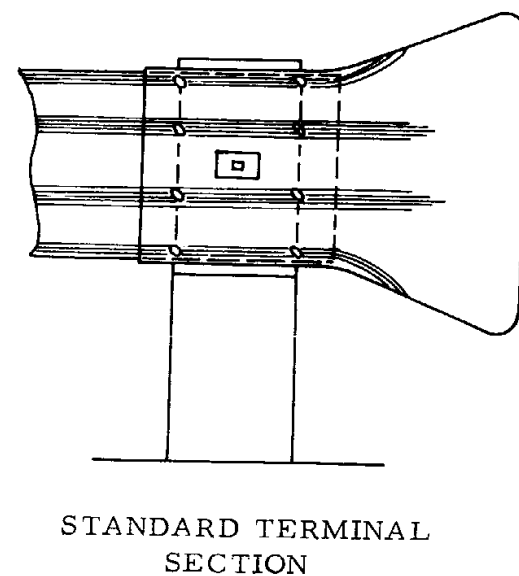
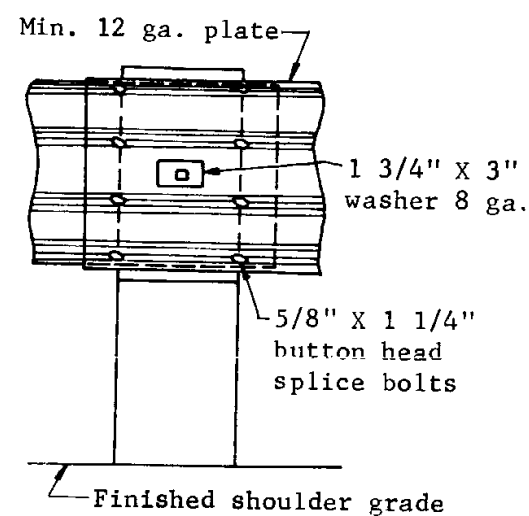
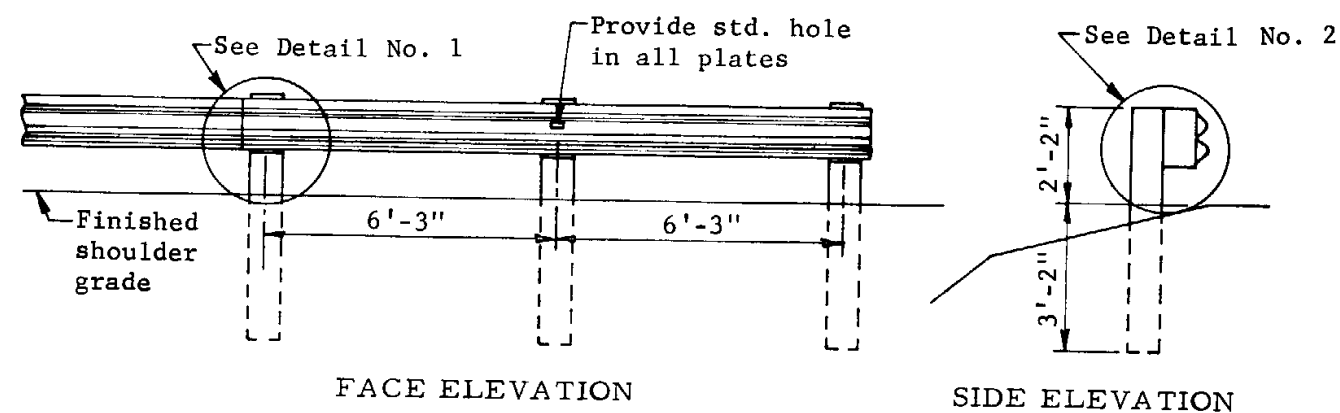
NO SCALE



GENERAL NOTES

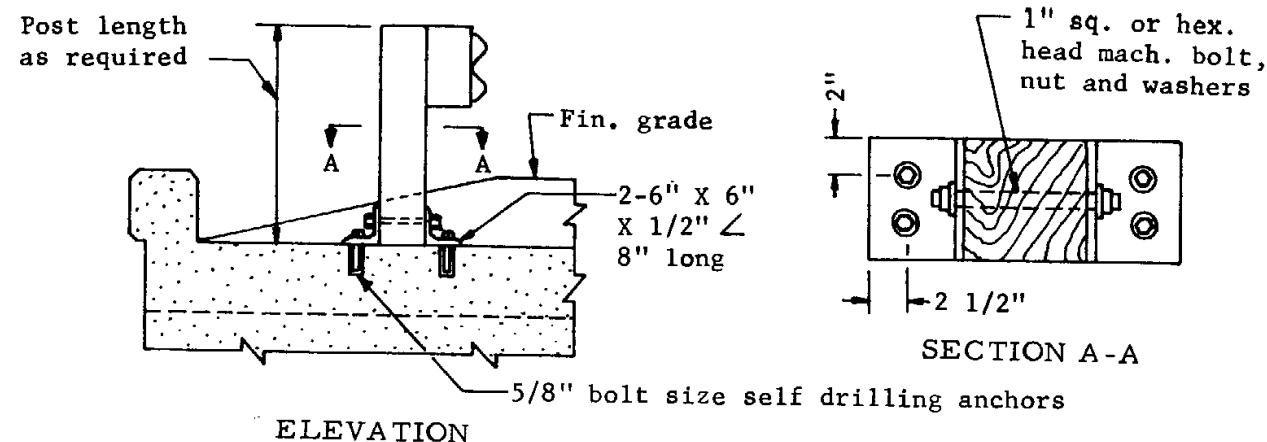
Posts and blocks shall be nominal 8" X 8" rough, pressure treated and unpainted. Holes shall be bored before treatment.

All guard rail plate, fittings, hardware, etc. shall be galvanized.

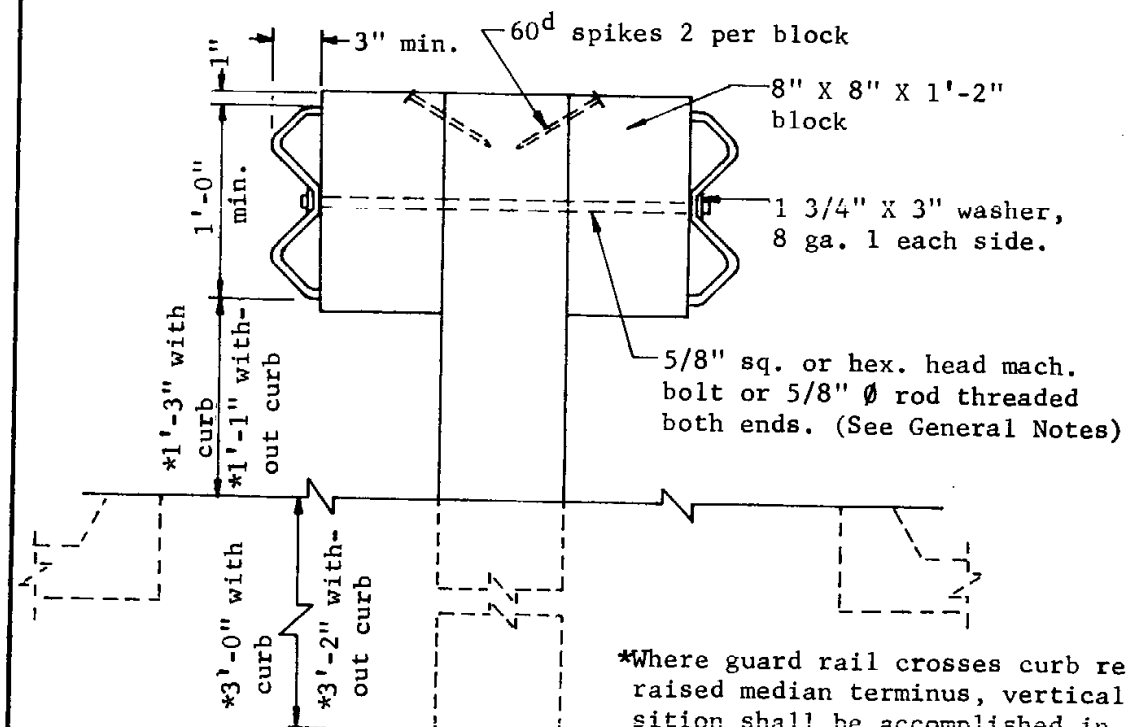


Installation of Guard Rail in embankment curb sections.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
GUARD RAIL-STEEL SINGLE FACE DETAILS			
Drawn	D.G.	Drawing No. C-10.01	
Traced	S.L.T. 6-67		
Checked	J.P.O. <i>9/0 5-68</i>		
Approved	<i>W. H. H. 5-68</i>		
Engr. Plans			

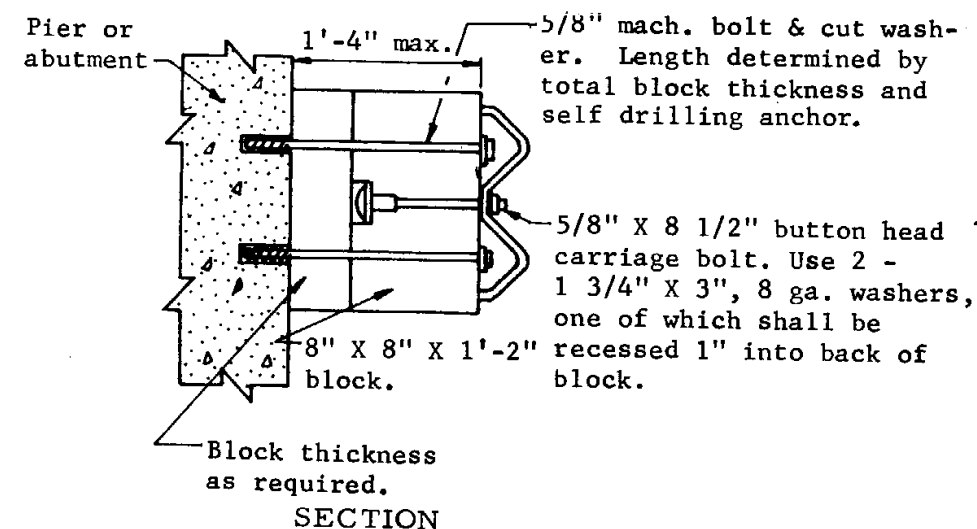


DETAIL NO. 1-GUARD RAIL POST INSTALLATION ON STRUCTURES

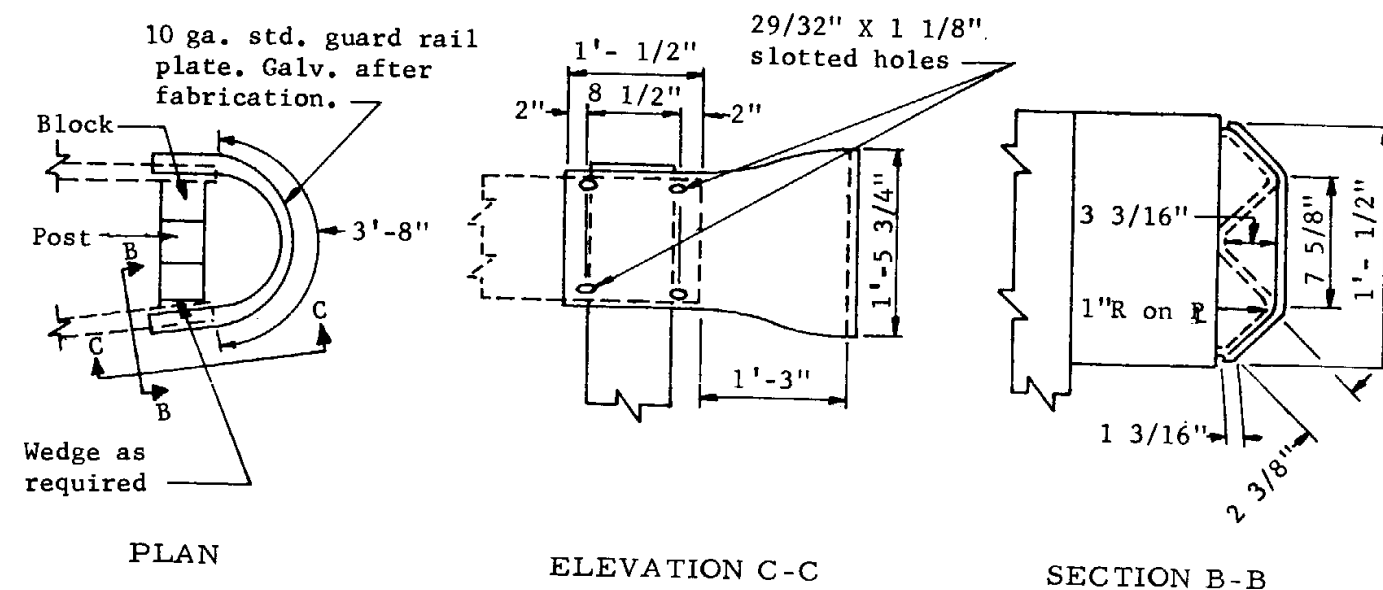


DETAIL NO. 2 - MEDIAN BARRIER

*Where guard rail crosses curb return at raised median terminus, vertical transition shall be accomplished in 12'-6" horizontally. Ream rail bolt holes as required.



DETAIL NO. 3 - ATTACHMENT OF GUARD RAIL TO PIERS



DETAIL NO. 4 - SPECIAL TERMINAL SECTION

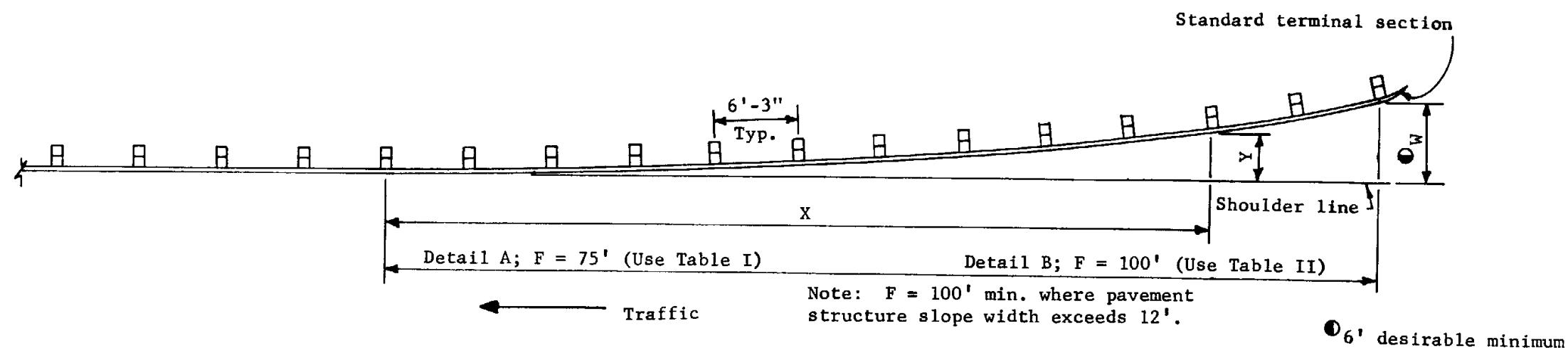
GENERAL NOTES

For other applicable guard rail details, see Std. C-10.01.

Bolt ends shall not project more than 1 1/2" beyond face of block. If adjustment shortening is required, threads shall be left in functional condition.

5/8" bolt size self drilling anchors shall have a min. 1500# pull out strength in 2500 p.s.i. concrete in accordance with manufacturer's specifications.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
GUARD RAIL - STEEL MISCELLANEOUS DETAILS			
Drawn	D.G. 5-67	Drawing No. C-10.02	
Traced	S.L.T. 9-67		
Checked	J.P.O. <i>9-68</i>		
Approved Engr. Plans	<i>5-68</i>		



GENERAL NOTES
 When the value of W and/or F is different than values shown in the tables, use the formula to compute applicable Y values.
 Where necessary, dimension F may be increased to provide better alignment and grade.

TABLE I

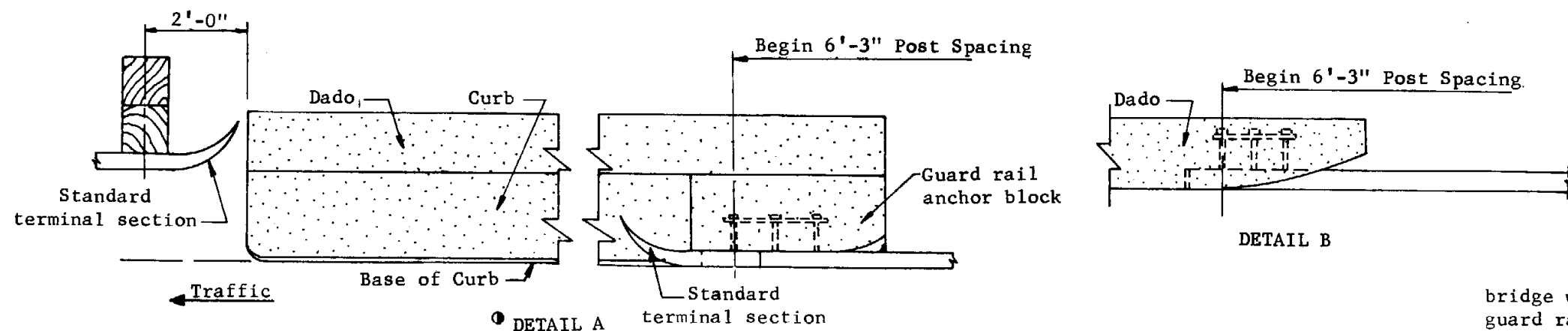
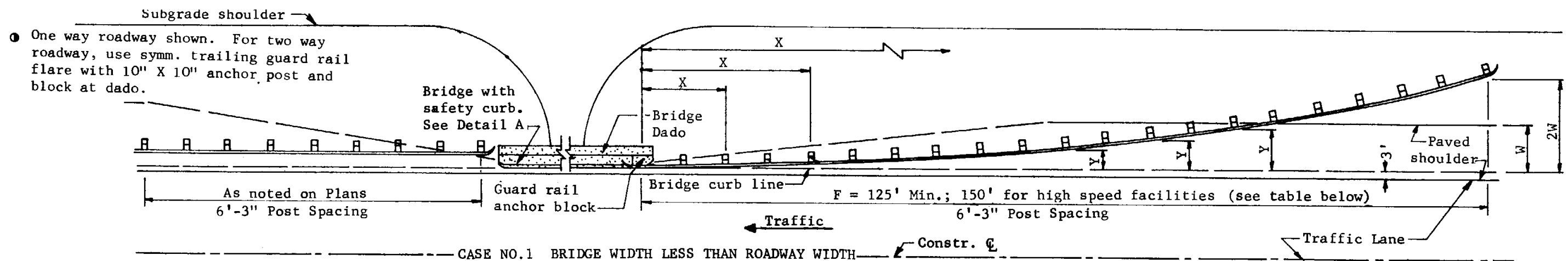
X	Y (Feet)			
	W			
	3'-0"	4'-0"	5'-0"	6'-0"
12'-6"	0.08	0.11	0.14	0.17
25'-0"	0.33	0.44	0.55	0.67
37'-6"	0.75	1.00	1.25	1.50
50'-0"	1.33	1.78	2.22	2.67
62'-6"	2.08	2.78	3.42	4.11
75'-0"	3.00	4.00	5.00	6.00

TABLE II

X	Y (Feet)					
	W					
	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"
12'-6"	0.08	0.09	0.11	0.12	0.14	0.16
25'-0"	0.31	0.37	0.44	0.50	0.56	0.62
37'-6"	0.70	0.84	0.99	1.13	1.27	1.41
50'-0"	1.25	1.50	1.75	2.00	2.25	2.50
62'-6"	1.90	2.28	2.66	3.01	3.42	3.91
75'-0"	2.81	3.39	3.94	4.50	5.06	5.62
87'-6"	3.81	4.57	5.34	6.10	6.86	7.66
100'-0"	5.00	6.00	7.00	8.00	9.00	10.00

$Y = (W)X^2/F^2$ = Offset from shoulder line to guard rail.
 W = Distance between shoulder line and desired location of end of guard rail.
 F = Length of flared guard rail.
 X = Distance from beginning of parabolic flare.
 6'-0" indicates the preferred value.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
GUARD RAIL-STEEL APPROACH END TREATMENT		
Drawn	D.G.	Drawing No.
Traced	D.G. 4-3-67	C-10.03
Checked	J.P.O. 9/10 5-68	
Approved Engr. Plans	5/11/68 5-68	



GENERAL NOTES

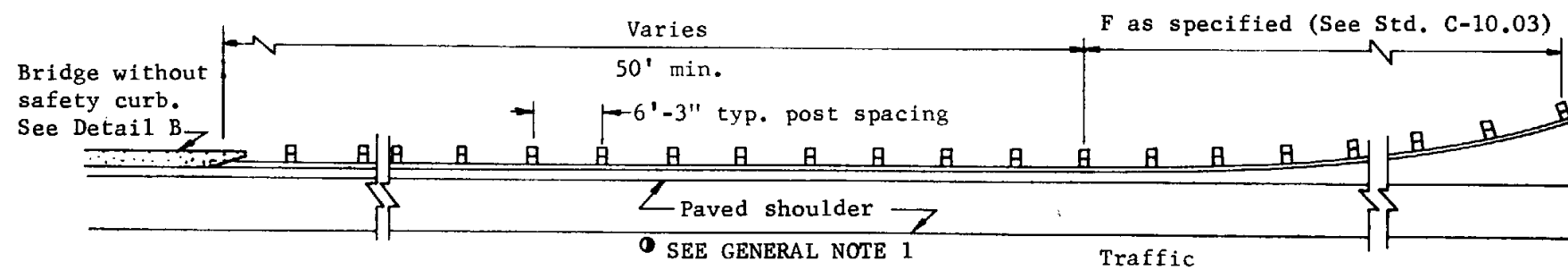
For shoulder widths less than 5' or when bridge width equals roadway width, use straight guard rail with flared approach end treatment.

When guard rail is continued beyond the required flare, the last four flare panels shall be modified to avoid a sharp change in direction.

When the value of W and/or F is different than values shown in the table, use the formula to compute applicable Y values.

For construction details of guard rail attachment to bridge, see Plans.

Where necessary, dimension F may be increased to provide better alignment and grade.



Shoulder Width	X W	12'-6"	25'-0"	37'-6"	50'-0"	62'-6"	75'-0"	87'-6"	100'-0"	112'-6"	125'-0"	137'-6"	150'-0"	X F
5'	2'	0.04	0.16	0.36	0.64	1.00	1.44	1.96	2.56	3.24	4.00			125'
8'	5'	0.10	0.40	0.90	1.60	2.50	3.60	4.90	6.40	8.10	10.00			125'
8'	5'	0.07	0.28	0.63	1.11	1.74	2.50	3.40	4.44	5.63	6.94	8.40	10.00	150'
10'	7'	0.14	0.56	1.26	2.24	3.50	5.04	6.86	8.96	11.34	14.00			125'
10'	7'	0.10	0.39	0.87	1.54	2.42	3.50	4.76	6.23	7.88	9.72	11.76	14.00	150'

$$\text{Formula: } Y = 2W(X^2/F^2)$$

W = Distance between curb line extended and shoulder line of approach roadway.

F = Length of flared guard rail.

X = Distance from first post at bridge to any 12'-6" multiple of guard rail flare.

Y = Offset from curb line to face of guard rail.

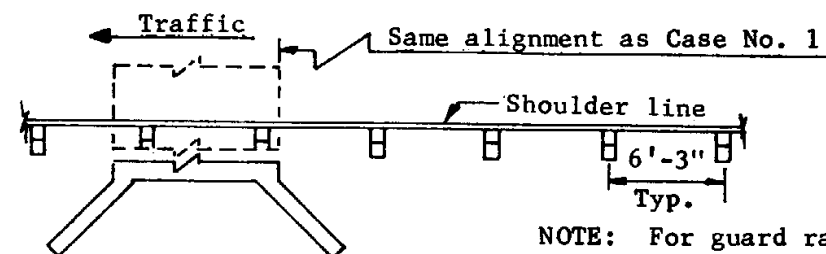
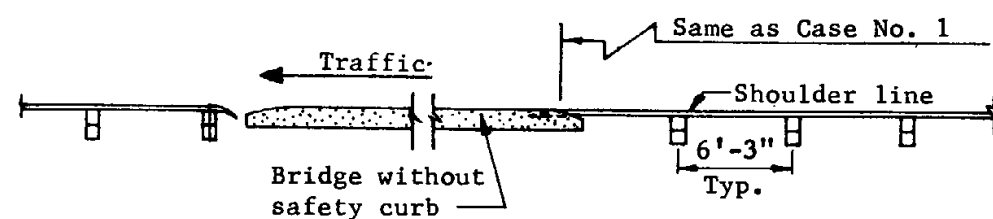
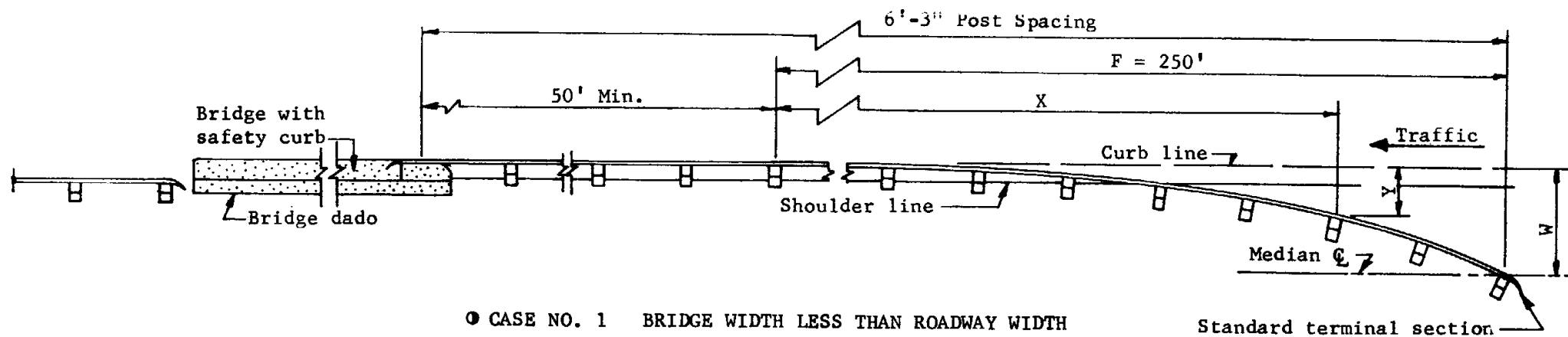
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

GUARD RAIL-STEEL DETAIL AT BRIDGE APPROACHES

Drawn	D.G.	Drawing No.
Traced	S.L.T. 9-67	
Checked	J.P.O. 8PD 5-68	
Approved		
Engr. Plans	5-68	

C-10.04

Rev



NOTE: For guard rail post installation on structures, see Std. C-10.02

GENERAL NOTES

When the value of W and/or F is different than values shown in the table, use the formula to compute applicable Y values.

For construction details of guard rail attachment to bridge, see Std. C-10.04 and Plans.

Where necessary, dimension F may be increased to provide better alignment and grade.

X	Y(Feet)				
	W				
	26'	30'	34'	38'	42'
12'-6"	.065	.075	.085	.095	.105
25'-0"	.260	.300	.340	.38	.42
37'-6"	.585	.675	.765	.86	.95
50'-0"	1.040	1.200	1.360	1.52	1.68
62'-6"	1.625	1.875	2.125	2.38	2.63
75'-0"	2.340	2.700	3.060	3.42	3.78
87'-6"	3.185	3.675	4.165	4.66	5.15
100'-0"	4.16	4.800	5.440	6.08	6.72
112'-6"	5.265	6.075	6.885	7.70	8.51
125'-0"	6.500	7.500	8.500	9.50	10.50
137'-6"	7.865	9.075	10.285	11.50	12.71
150'-0"	9.360	10.800	12.240	13.68	15.12
162'-6"	10.985	12.675	14.365	16.06	17.75
175'-0"	12.740	14.700	16.660	18.62	20.58
187'-6"	14.625	16.875	19.125	21.38	23.63
200'-0"	16.640	19.200	21.760	24.32	26.88
212'-6"	18.785	21.675	24.565	27.46	30.35
225'-0"	21.060	24.300	27.540	30.78	34.02
237'-6"	23.465	27.075	30.685	34.28	37.88
250'-0"	26.00	30.00	34.00	38.00	42.00

● One way roadway shown. For two way roadway, use symm. guard rail flare and fixed dado attachment at trailing end of bridge.

$$\text{Formula: } Y = (W) \frac{X^2}{F^2}$$

W = Distance between curb line extended (Case No. 1), or shoulder line (Case Nos. 2 & 3), and median center line.

F = Length of flared portion of guard rail.

X = Distance from beginning of parabolic flare to any 12'-6" multiple of parabolic flare.

Y = Offset from curb line or shoulder line to face of guard rail.

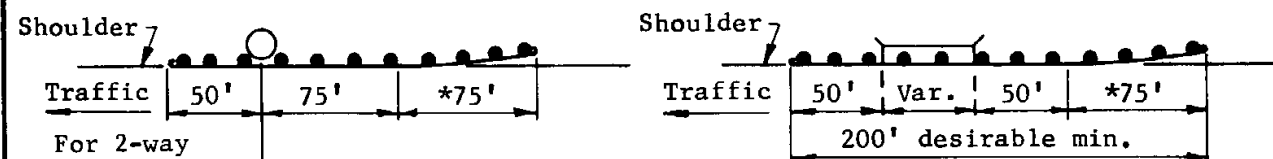
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

GUARD RAIL-STEEL FLARE TO MEDIAN

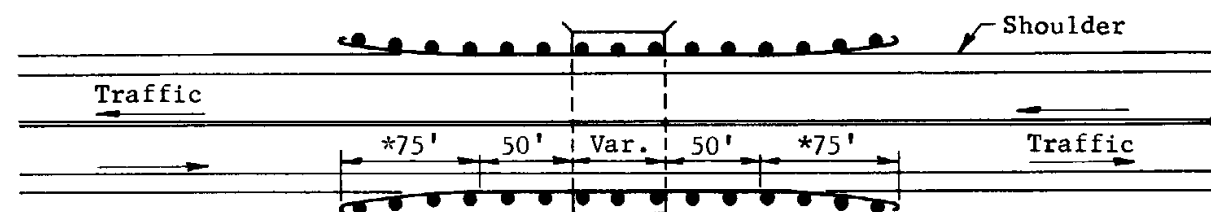
Drawn D.G.
Traced S.L.T. 9-67
Checked J.P.O. 9PO 5-68
Approved Engr. Plans *[Signature]*

Drawing No.
C-10.05

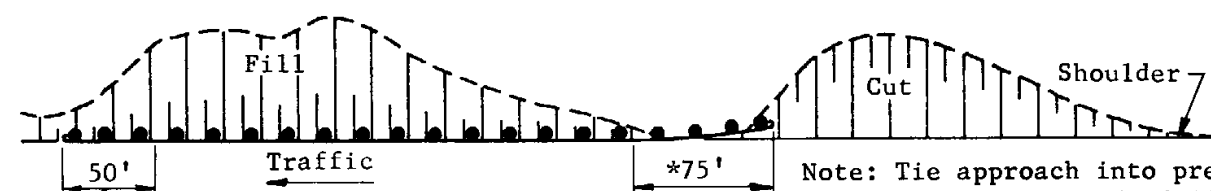
Rev



ISOLATED INSTALLATION
1-Way Roadway

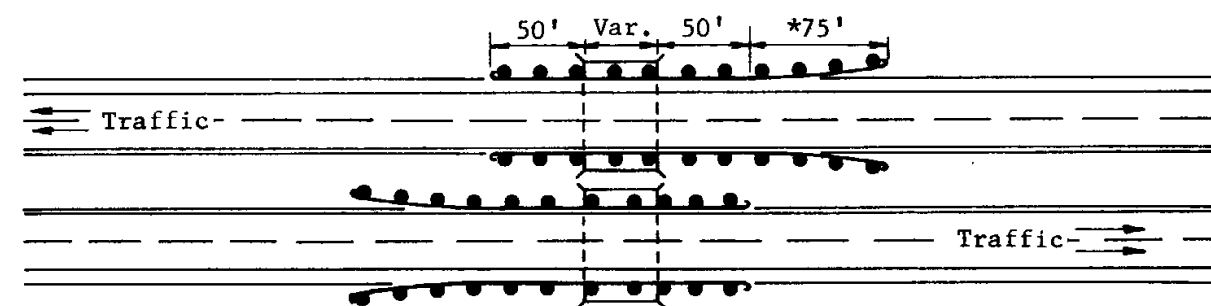


2-WAY ROADWAY OBSTRUCTION

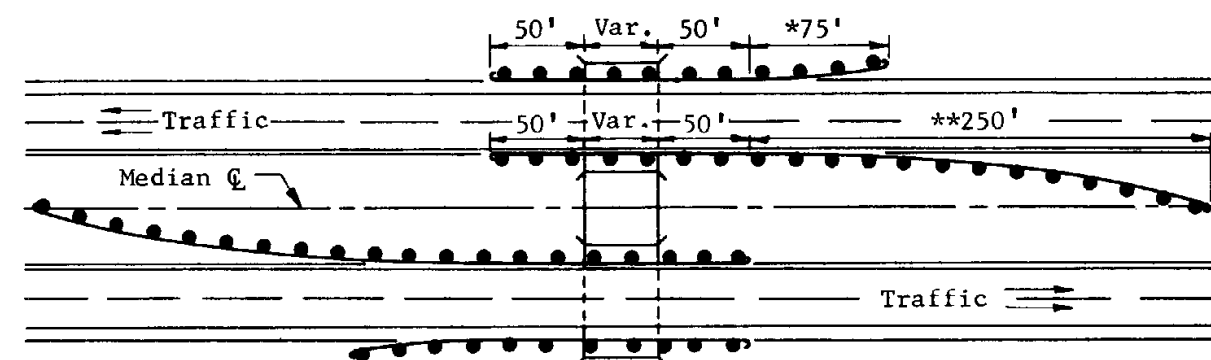


FILL PROTECTION

Note: Tie approach into preceding cut. If no cut precedes fill, begin approach end treatment 125' prior to required area.

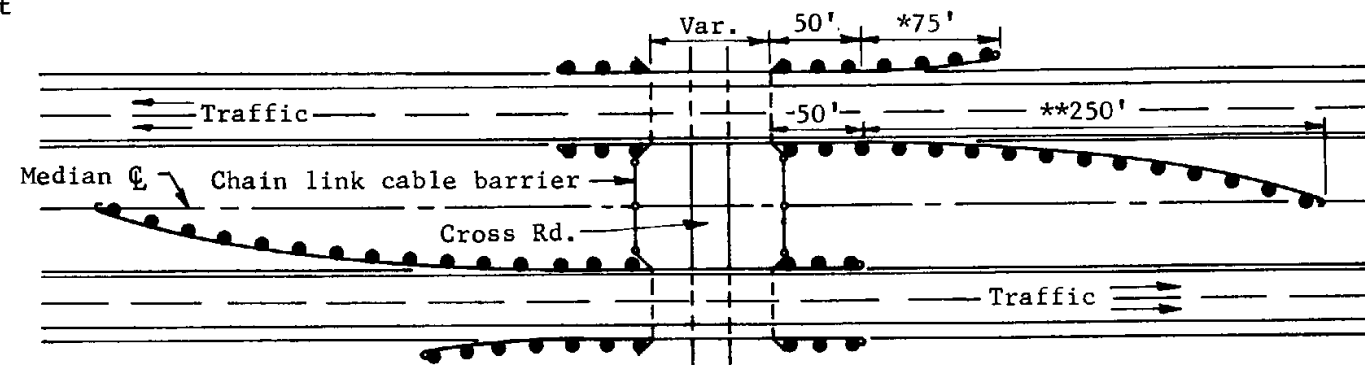


BOX CULVERT WITH DRIVABLE MEDIAN



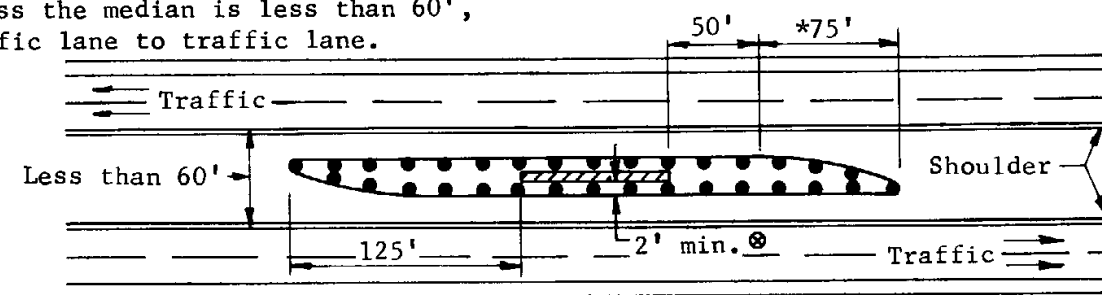
BOX CULVERT WITHOUT DRIVABLE MEDIAN

* Min. Std. approach
end treatment
** Std. median
flare



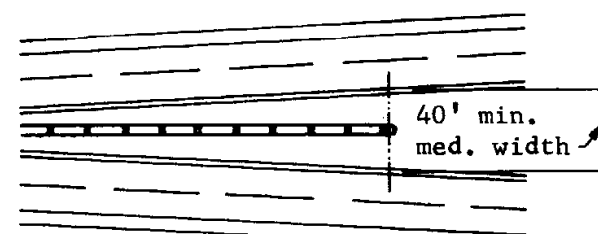
BRIDGE STRUCTURE WITH CROSS ROAD

No guard rail is normally required unless the median is less than 60', traffic lane to traffic lane.

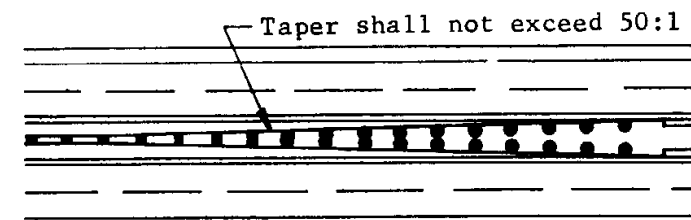


⊗ If distance from face of pier to face of guard rail is less than 2' attach guard rail to pier.

MEDIAN BRIDGE OR SIGN STANDARDS



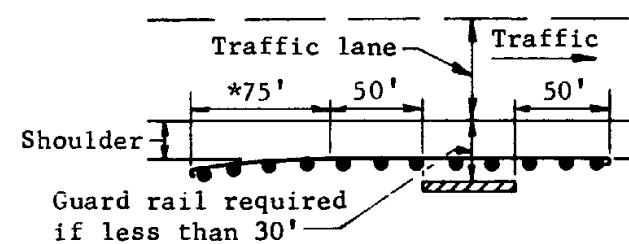
MEDIAN BARRIER TERMINUS



BARRIER TRANSITION AT OVERPASS

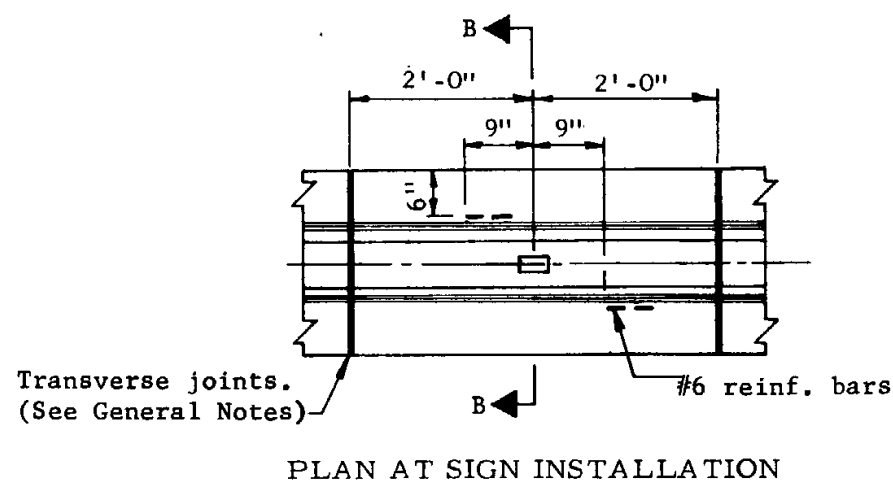
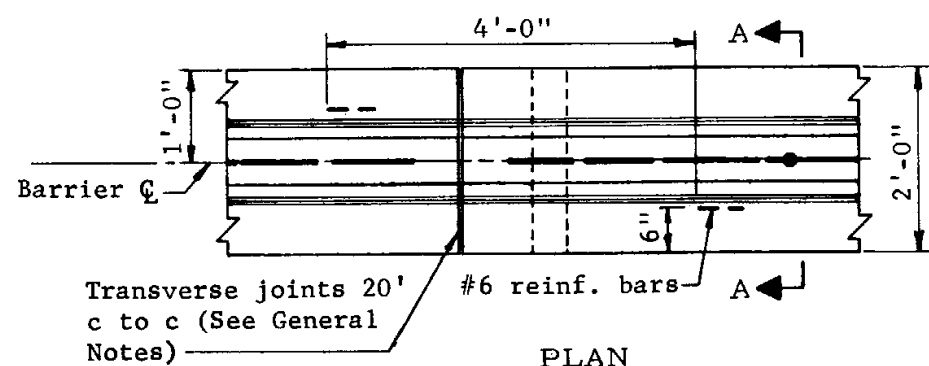
GENERAL NOTES

These drawings DO NOT establish warrants for guard rail installation, Post spacing shall be 6'-3" throughout.

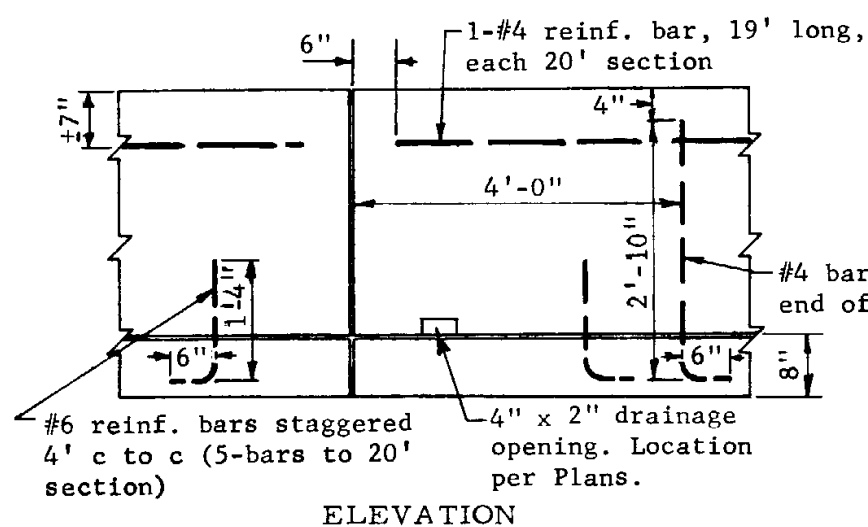


PIER, ABUTMENT OR SIGN BASE
RIGHT SIDE OF ROADWAY

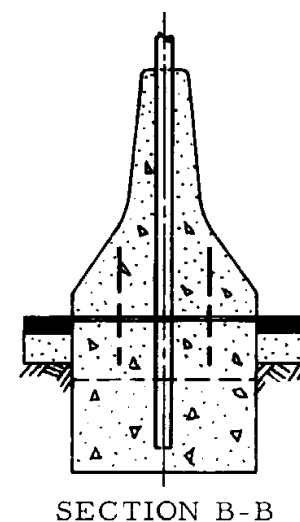
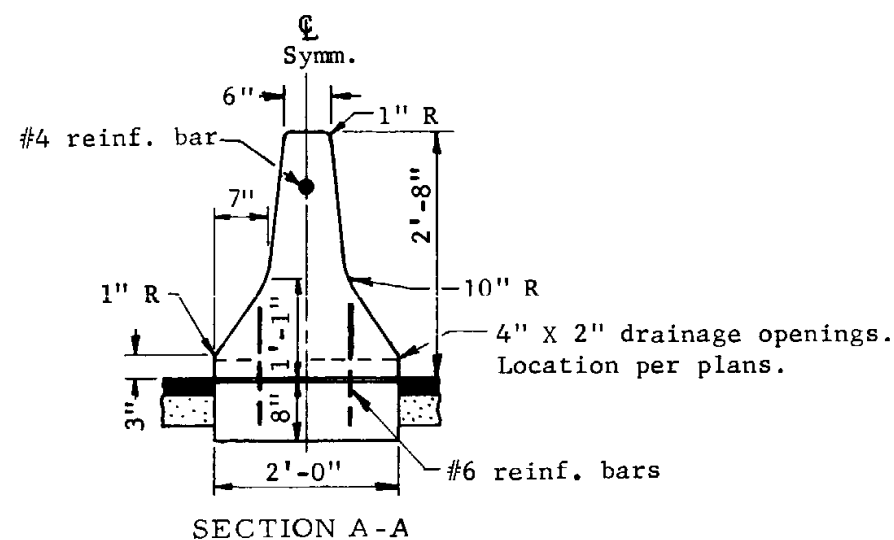
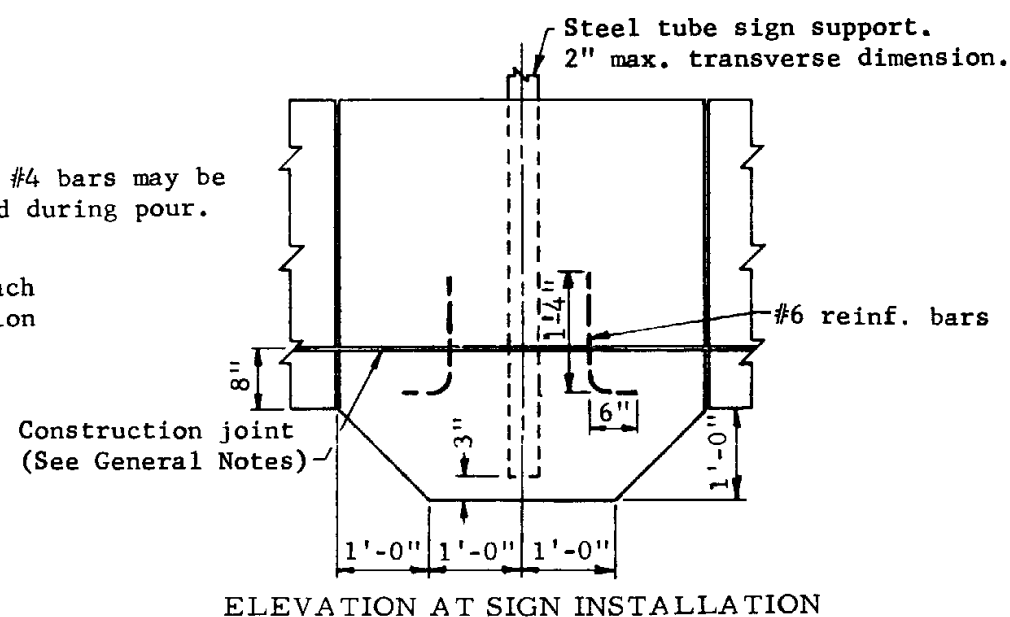
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
GUARD RAIL-STEEL TYPICAL INSTALLATIONS			
Drawn	S.L.T., R.A.F.		Drawing No. C-10.06
Traced	R.A.F. 9-67		
Checked	J.P.O. 890 5-68		
Approved Engr. Plans	[Signature] 5-68		



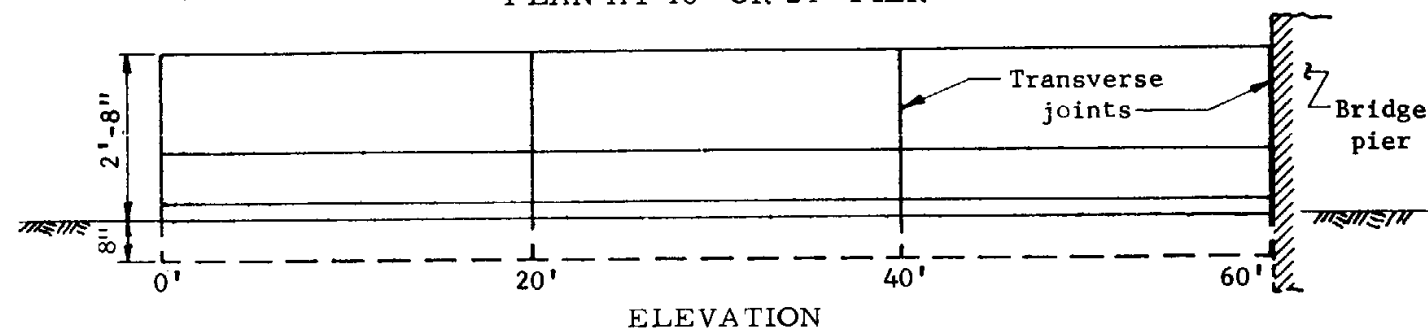
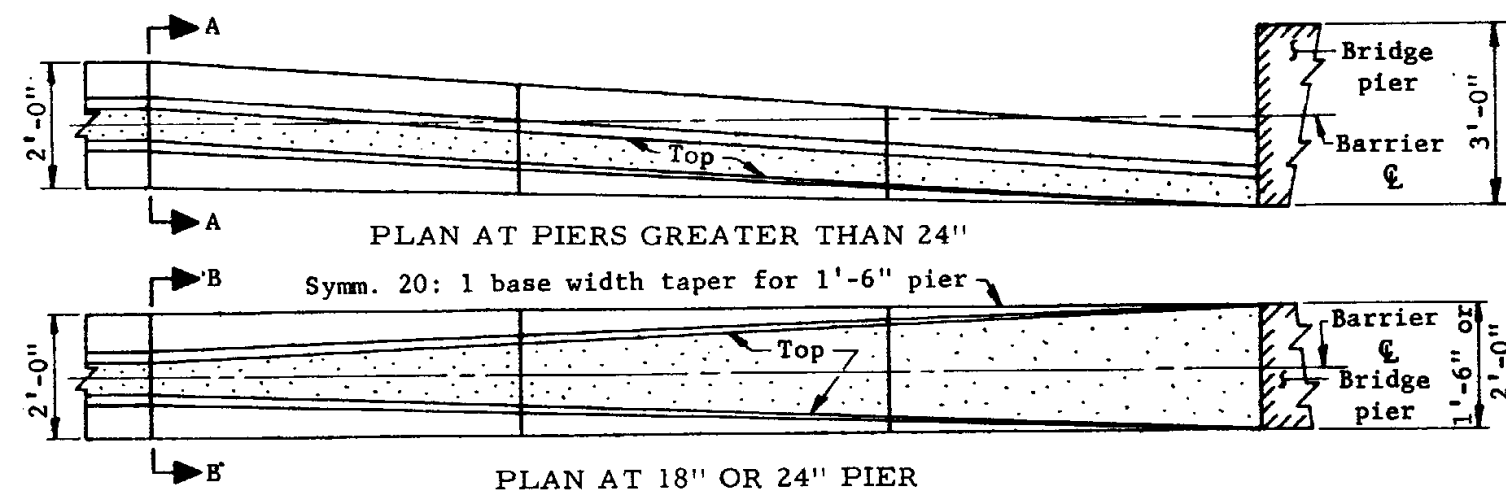
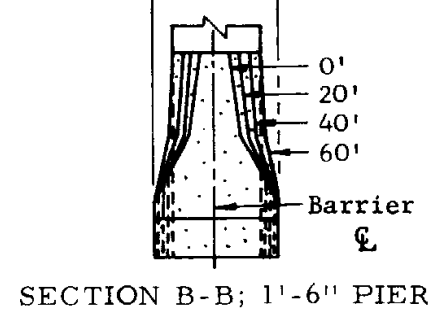
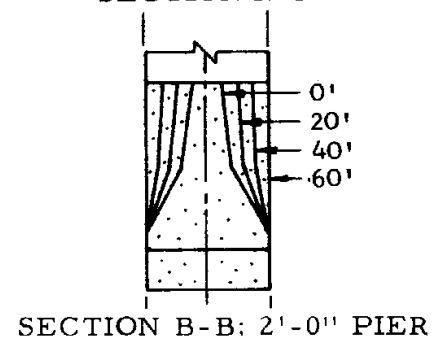
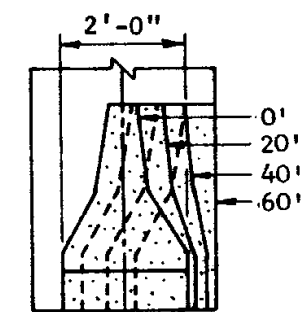
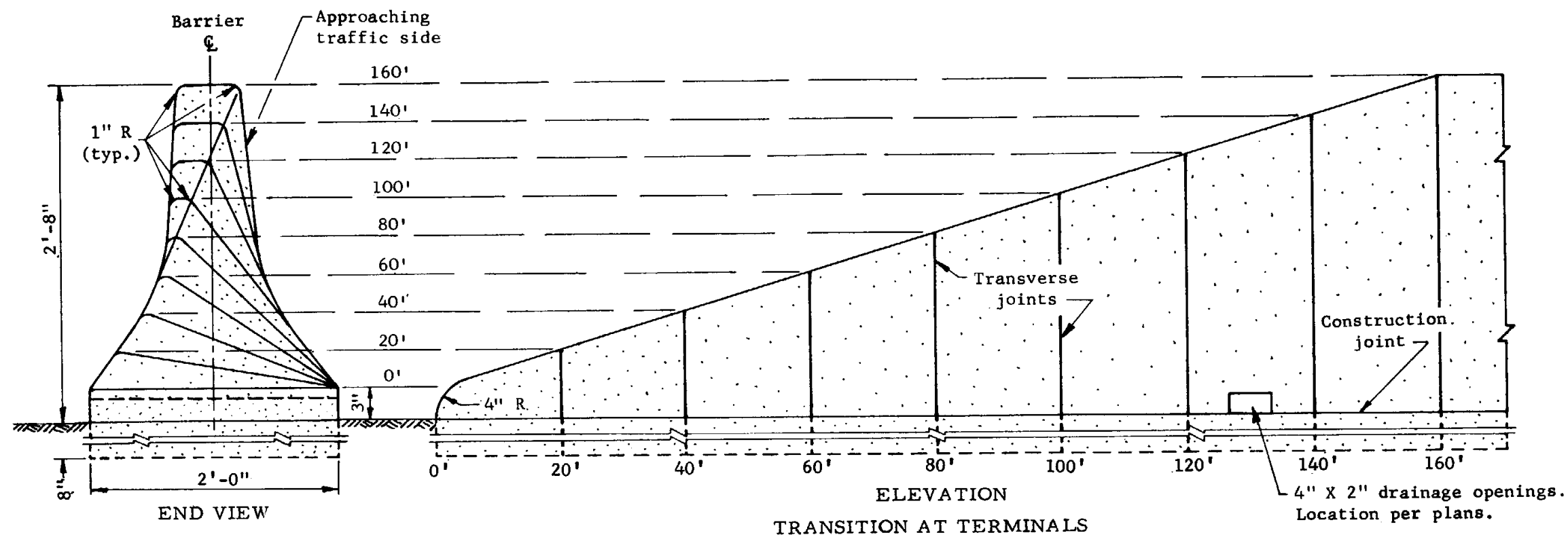
GENERAL NOTES
 All concrete shall be Class A.
 Transverse joints shall extend through the foundation slab. For continuous or sectional construction, use a 1/4" open joint. Edge joints with a 1/4" radius tool.
 Construction joint and #6 bars may be eliminated when barrier and foundation slab are poured monolithic.
 For details of transition at terminals and structures, see Std. C-10.09.



Note: #4 bars may be placed during pour.



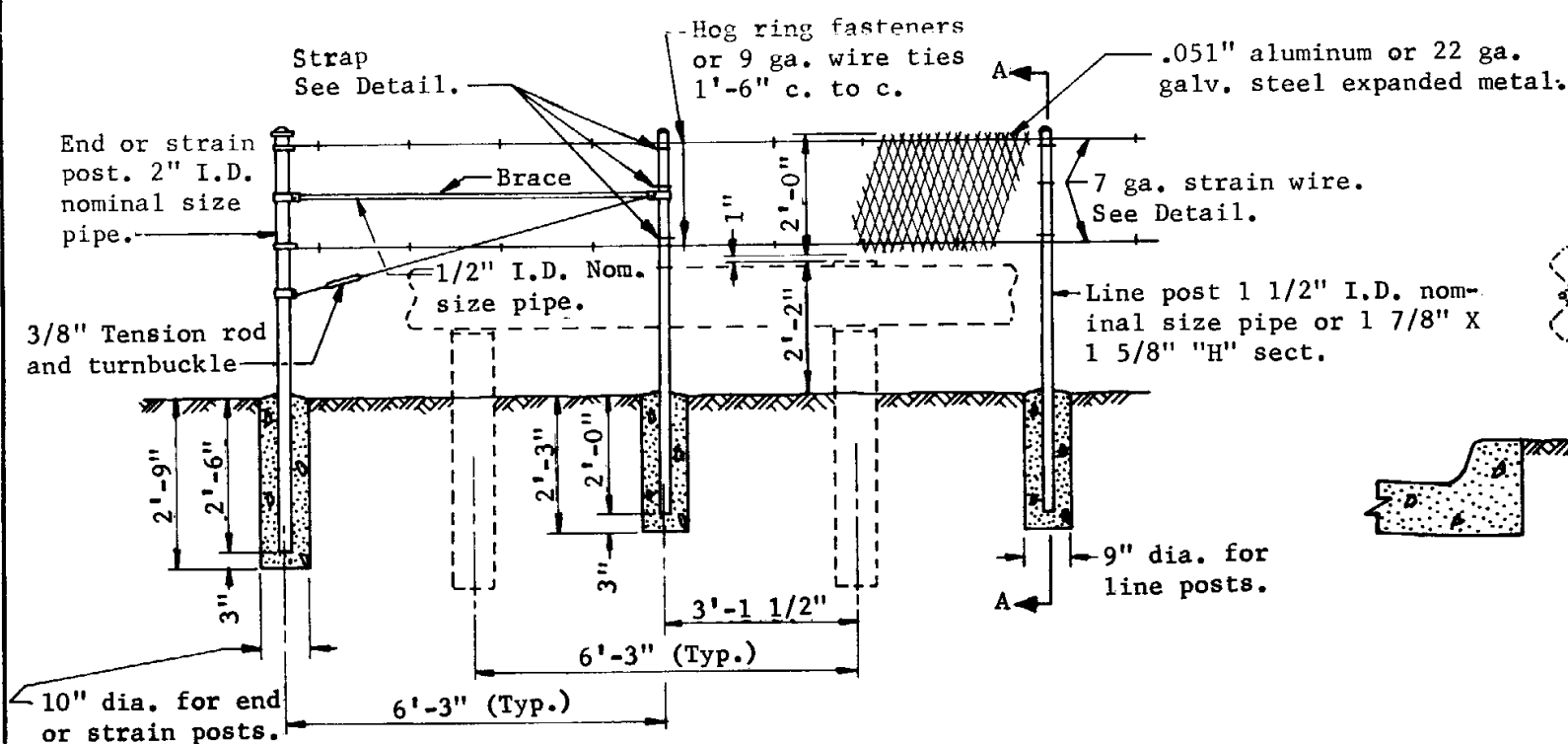
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
MEDIAN BARRIER CONCRETE			
Drawn	D.G.	Drawing No.	C-10.08
Traced	R.A.F. 8/67		
Checked	J.P.O. <i>JPO 5-68</i>		
Approved Engr. Plans	<i>W. H. H. 5-68</i>		



TYPICAL TRANSITION AT BRIDGE PIERS

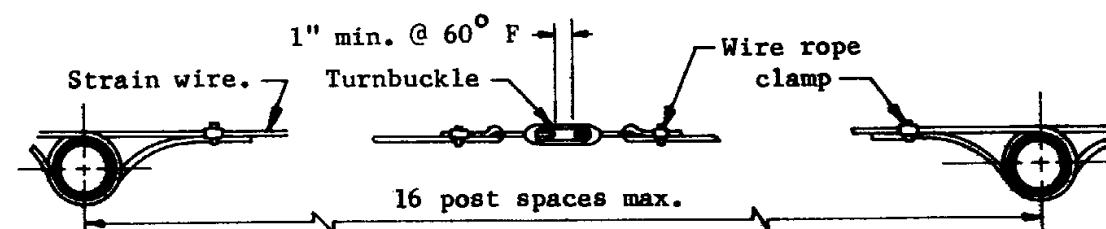
GENERAL NOTES
 All concrete shall be Class A.
 Faces of median barrier shall provide a smooth transition.
 For median barrier construction details, see Std. C-10.08.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CONCRETE MED. BARRIER TRANSITION DETAILS			
Drawn	D.G. 7/67	Drawing No. C-10.09	
Traced	R.A.F. 8/67		
Checked	J.P.O. 8/68		
Approved Engr. Plans	H. Heidrich 5-68		

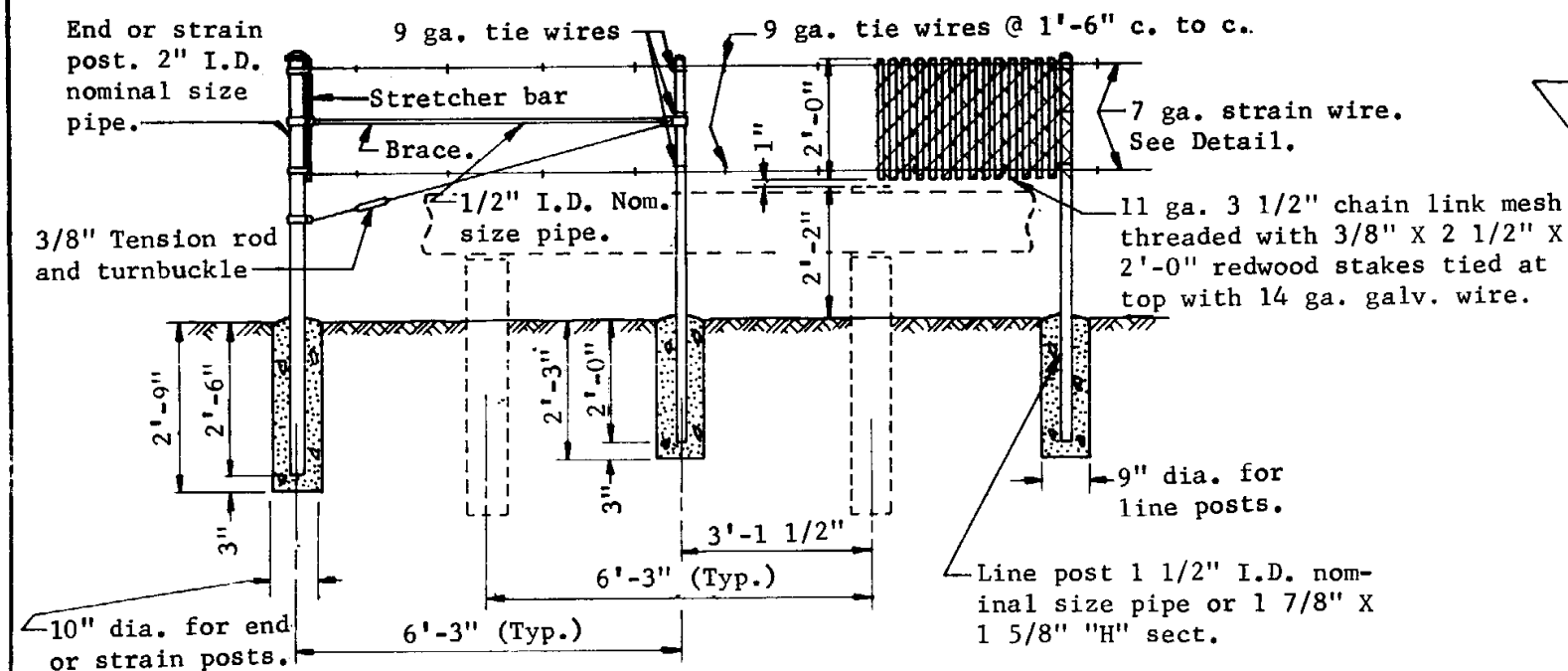


EXPANDED METAL GLARE SCREEN

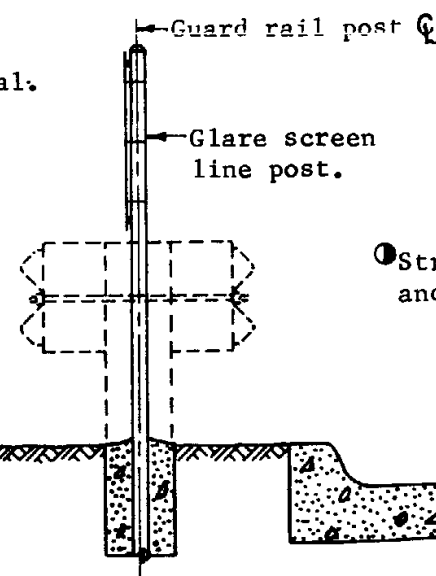
Note: Place intermediate strain posts at 500' (max.) intervals with brace and tension rod each side. If chain link fence type is used, place stretcher bar on each side.



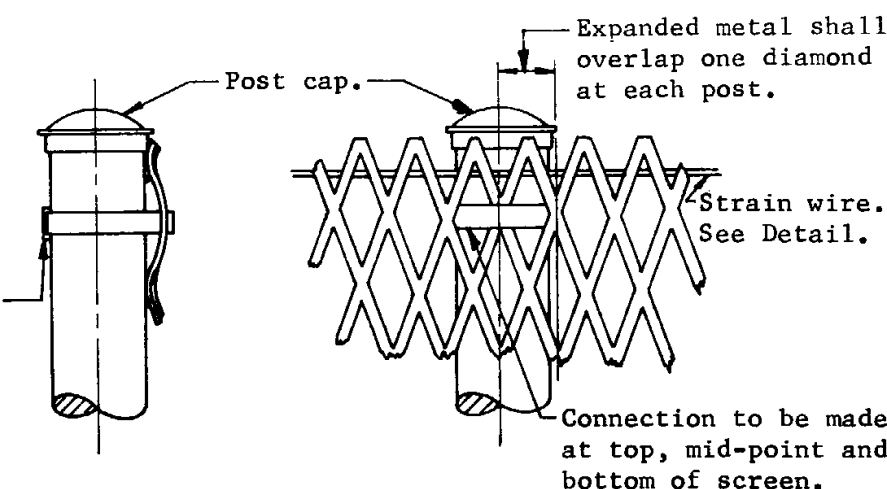
STRAIN WIRE DETAIL



CHAIN LINK FENCE GLARE SCREEN



SECTION A-A



EXPANDED METAL POST CONNECTION DETAIL

① Stainless steel strapping with aluminum expanded metal.
Galvanized steel strapping with steel expanded metal.

GENERAL NOTES

For guard rail details, see appropriate Guard Rail Standard.

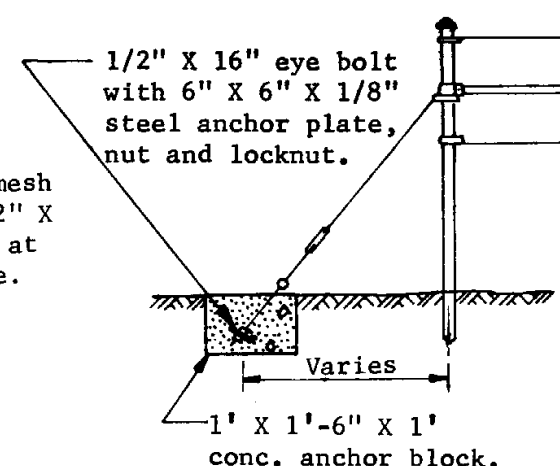
There shall be no connection made between the glare screen and the guard rail.

All steel materials, except stainless, shall be galvanized in accordance with ASTM A-123.

All pipe posts shall be capped.

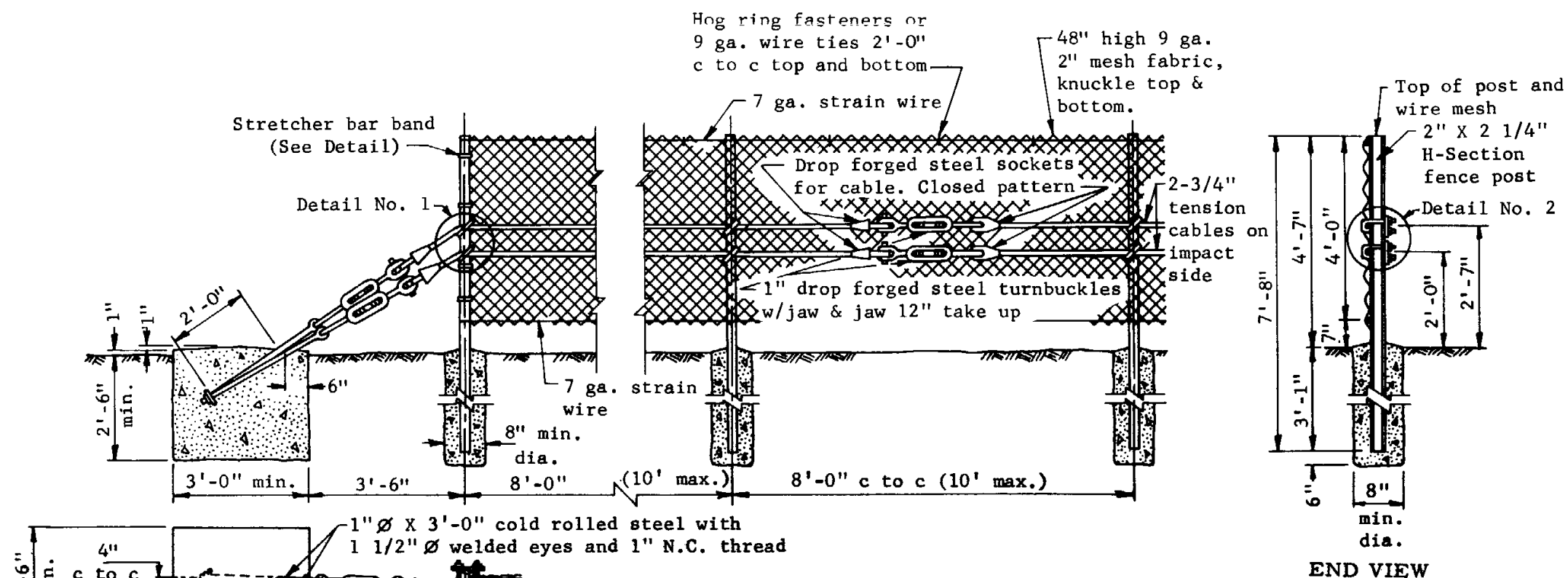
All concrete shall be Class A.

Expanded metal shall be 0.250" strand width with 1.33" X 4.0" bridge dimensions on tangents and 0.188" strand width with 0.93" X 2.0" bridge dimensions on curves.



ALTERNATE END POST TENSION ROD LOCATION

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
MEDIAN GLARE SCREEN			
Drawn	R.A.F. 4-67	Drawing No. C-10.10	
Traced	S.L.T. 7-67		
Checked	J.P.O. 9PO 5-68		
Approved Engr. Plans	Elmidecher 5-68		



ELEVATION

END VIEW

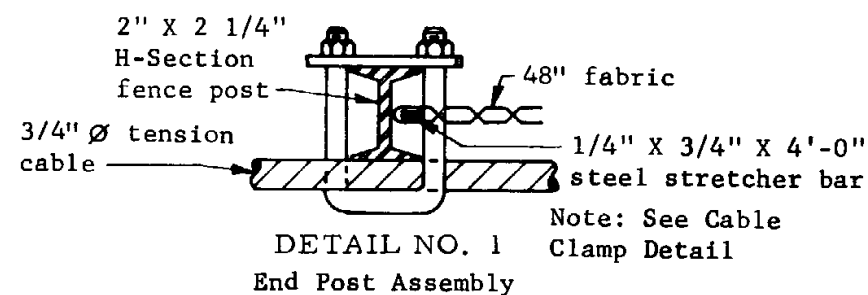
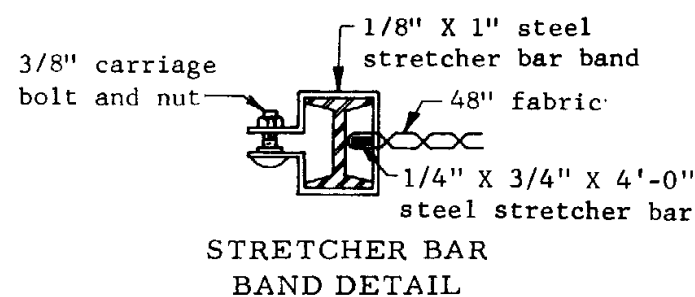
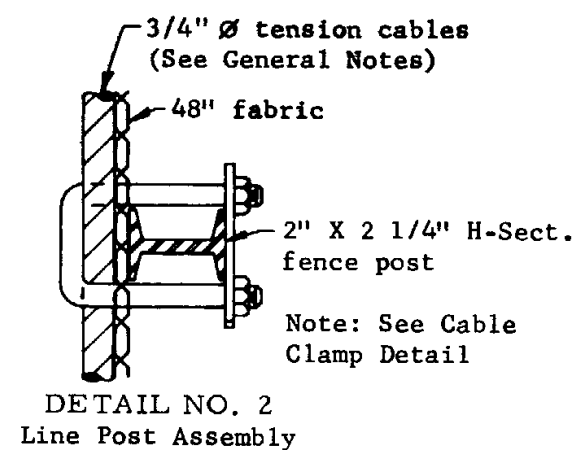
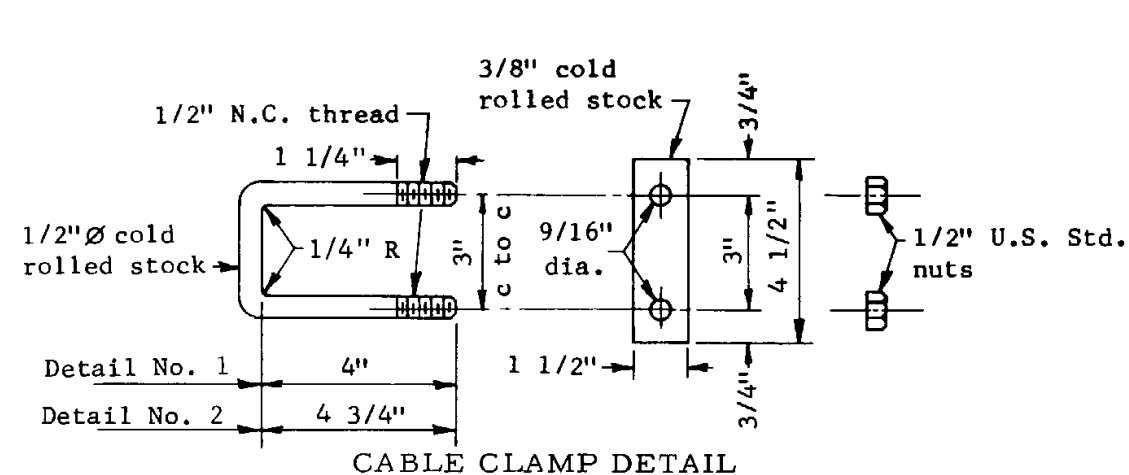
GENERAL NOTES

All concrete shall be Class A.

All material and fittings shall be galvanized in accordance with ASTM A 123.

3/4" tension cables shall be pre-formed, 6 X 19, hemp core, galvanized, right regular lay and of improved plow steel.

Fittings not specifically detailed shall be of approved, heavy duty design.

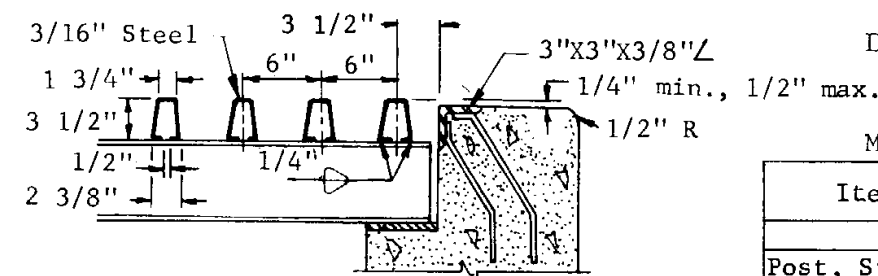
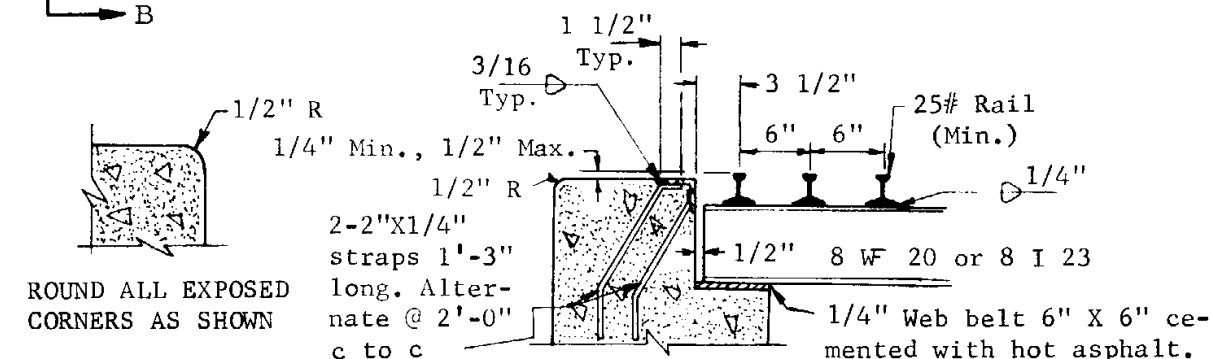
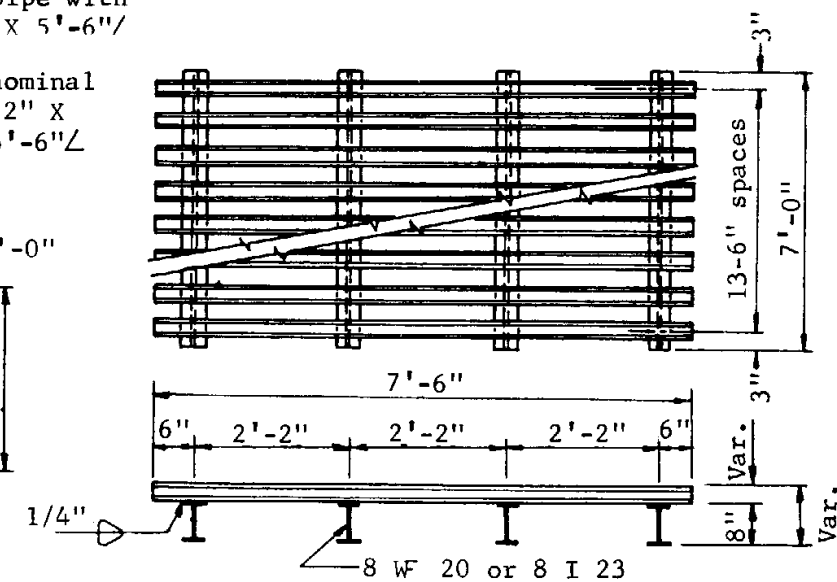
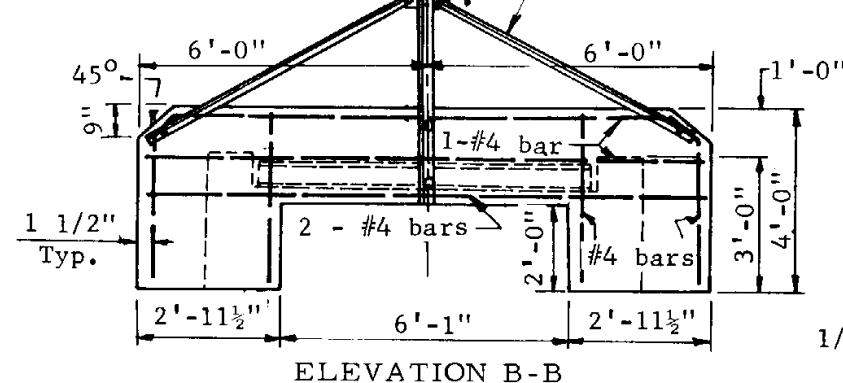
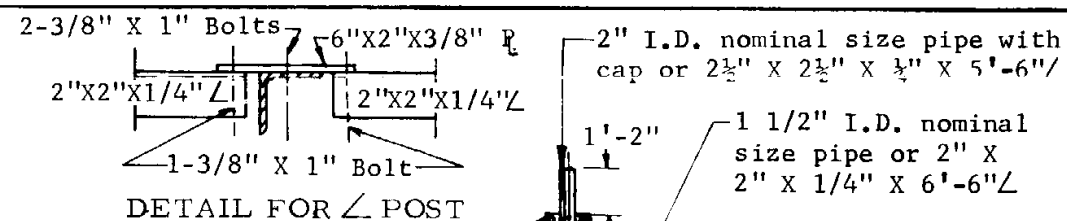
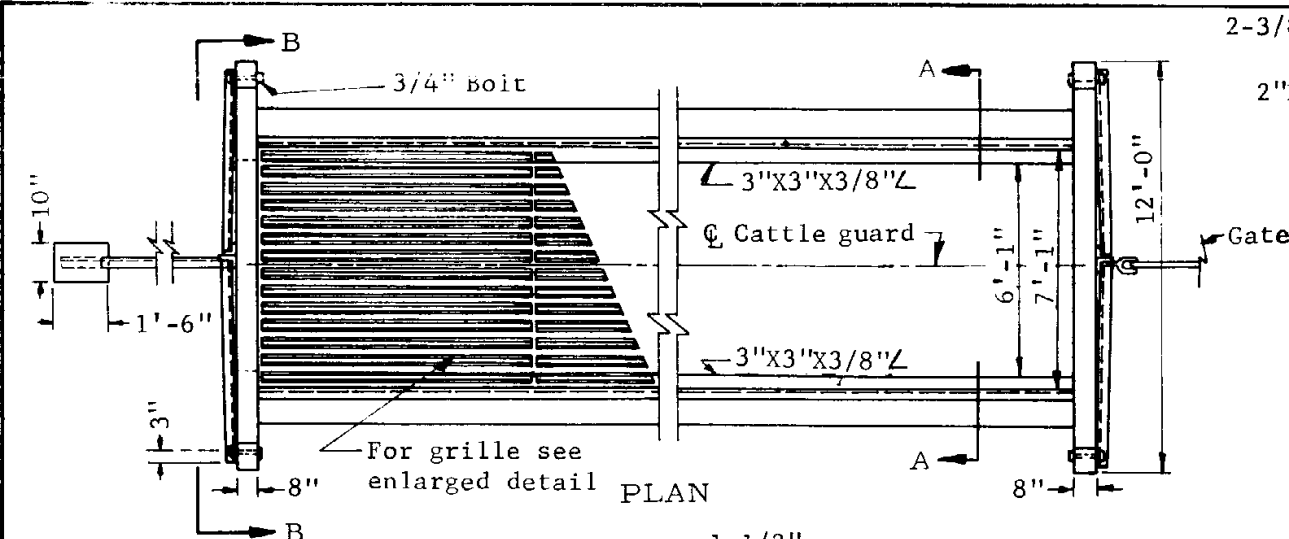


ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

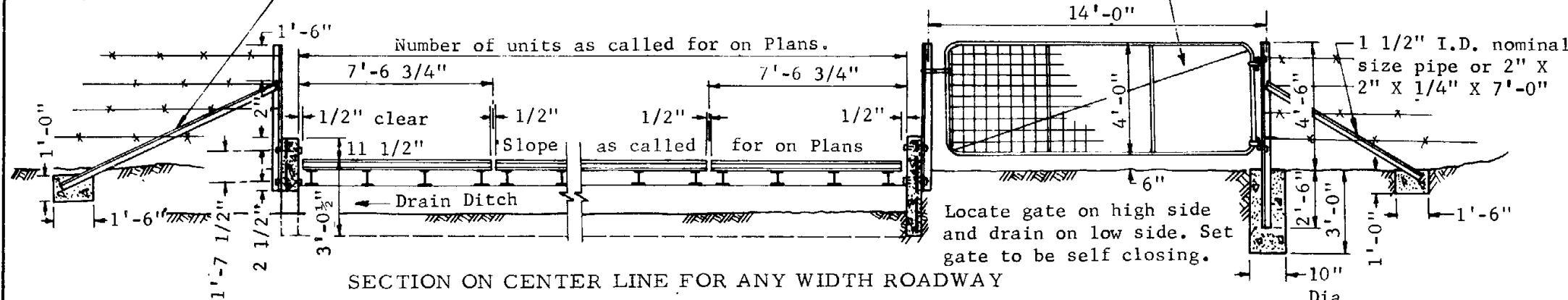
CHAIN LINK
CABLE BARRIER FENCE

Drawn	D.G.	Drawing No. C-10.11
Traced	R.A.F. 2-68	
Checked	J.P.O. <i>SPD 5-68</i>	
Approved Engr. Plans	<i>W. H. Decker</i>	

Rev



1 1/2" I.D. nominal size pipe or 2" X 2" X 1/4" X 10'-0" L

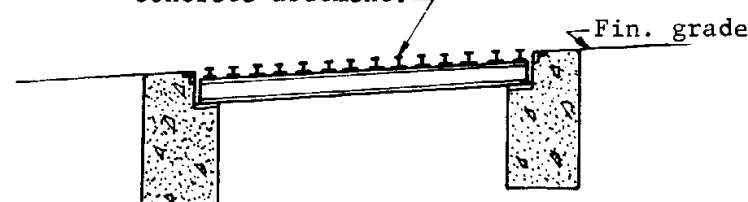


DETAIL OF WELDED GRILLE UNIT

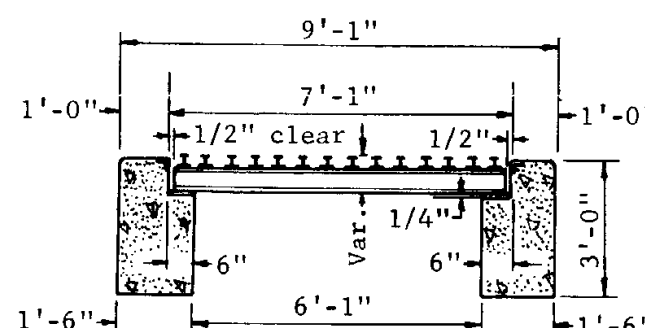
MATERIAL LIST - CATTLE GUARD WITH GATE

Item	Pcs.	Size	Length	Steel#	Conc. C.Y.
Common to all guard lengths					
Post, Steel	3	See Std. C-12.01			
Braces, Steel	6	See Std. C-12.01			
Conc. for setting Post & Braces					0.17
Reinf. Bars	8	#4	11'-6"	61.50	
Reinf. Bars	8	#4	3'-6"	18.70	
7 Unit - 40' ROADWAY					17.86
Fabricated L	2	3"X3"X3/8"X52'-10"			
Web Belting	56	6"X6"X1/2"			
6 Unit - 34' ROADWAY					15.60
Fabricated L	2	3"X3"X3/8"X45'-3 1/2"			
Web Belting	48	6"X6"X1/2"			
5 Unit - 26' ROADWAY					13.34
Fabricated L	2	3"X3"X3/8"X37'-9"			
Web Belting	40	6"X6"X1/2"			
4 Unit - 20' ROADWAY					11.08
Fabricated L	2	3"X3"X3/8"X30'-2 1/2"			
Web Belting	32	6"X6"X1/2"			

Rails to be set 1/4" min. to 1/2" max. above top of concrete abutment.



Section A-A showing relationship of top of concrete, and finished grade line.



SECTION A-A

GENERAL NOTES

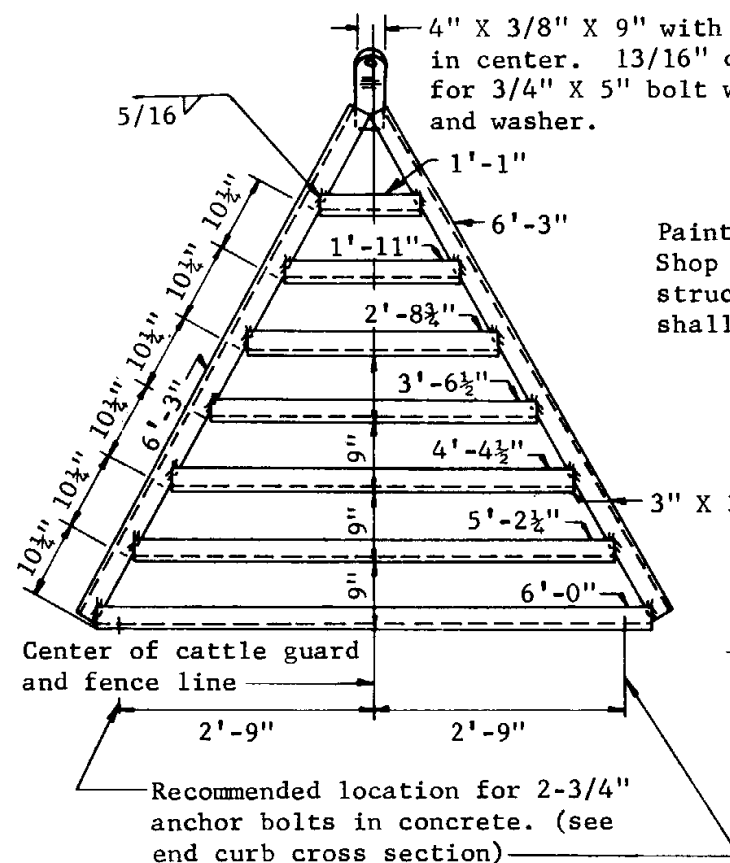
All concrete shall be Class A. Used rails may be used providing they are clean, free from rust, of uniform cross section and weigh 25 lbs./ft. min. All rails, structural steel, steel posts and braces shall be given one shop coat of No. 1 paint.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

CATTLE GUARD

Drawn	12-58	Drawing No. C-II.01
Traced	S.L.T. 5-67	
Checked	J.P.O. 8-68	
Approved Engr. Plans	<i>W. S. Schaefer</i> 5-68	

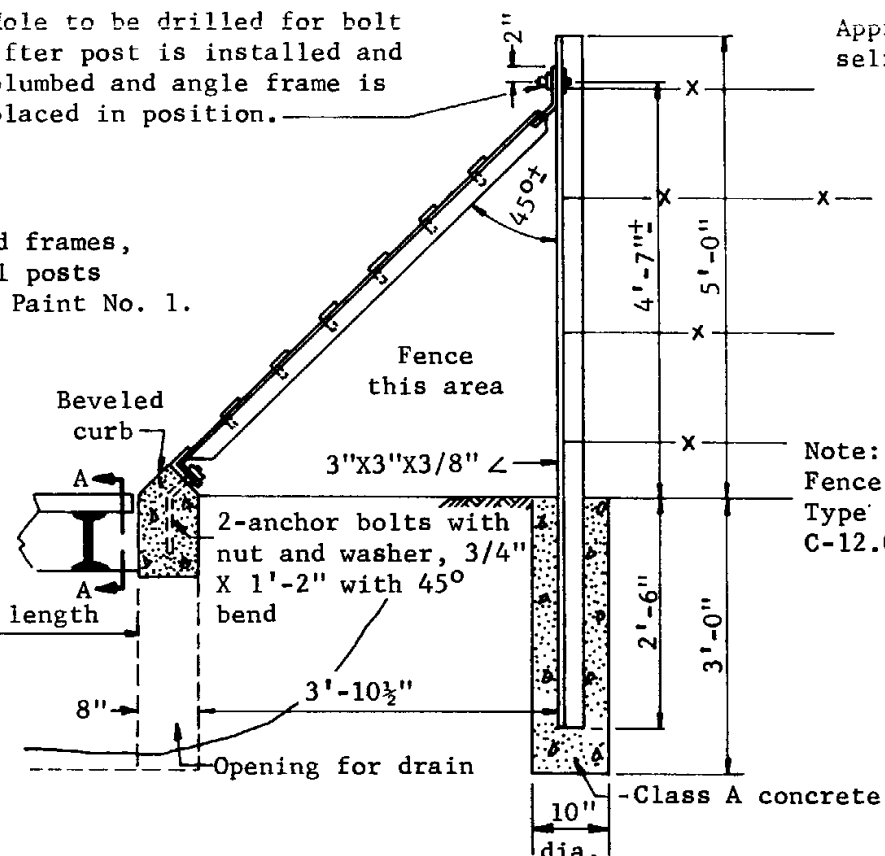
Rev



WELDED ANGLE END FRAME
2-required (one at each end)

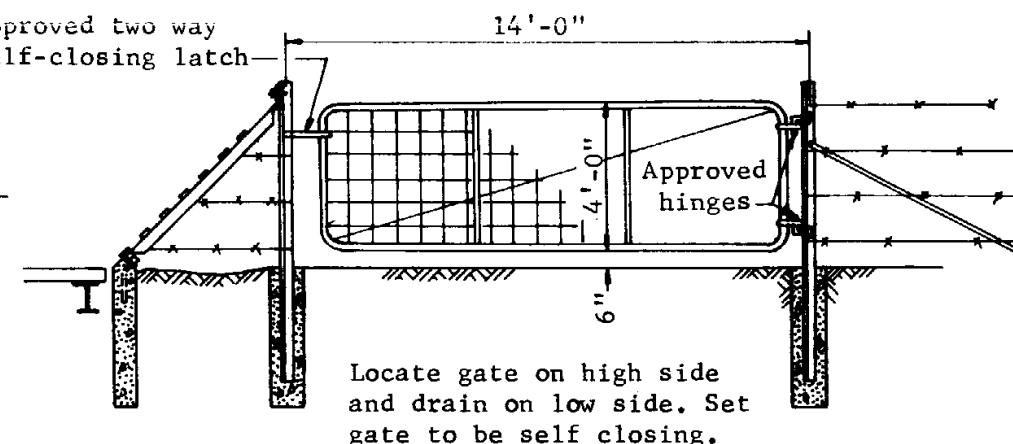
Paint Note:
Shop coat - All rails, end frames, structural steel and steel posts shall be painted one coat Paint No. 1.

Hole to be drilled for bolt after post is installed and plumbed and angle frame is placed in position.

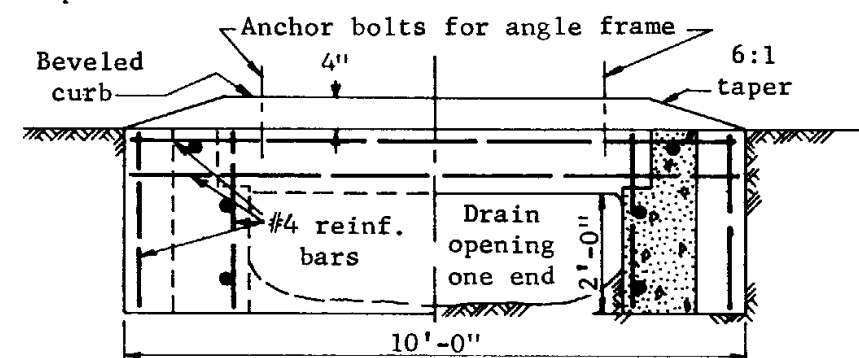


END CURB CROSS SECTION

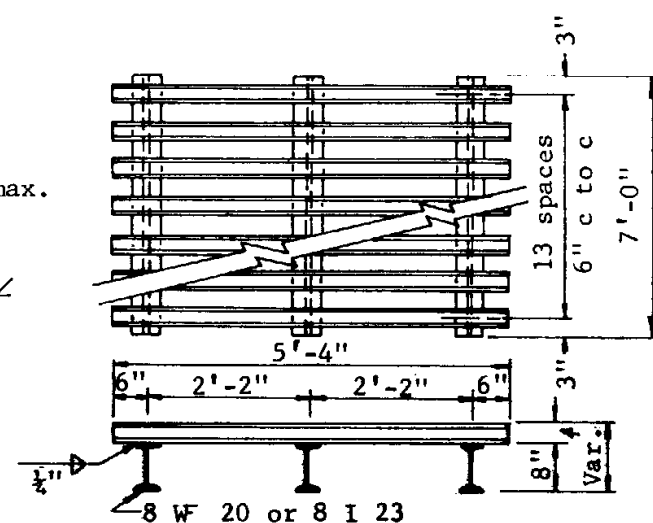
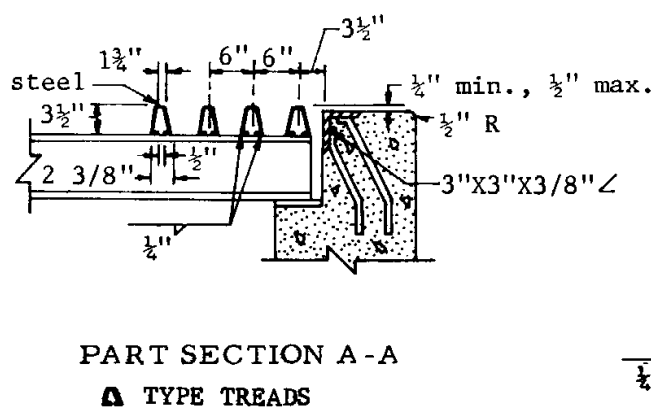
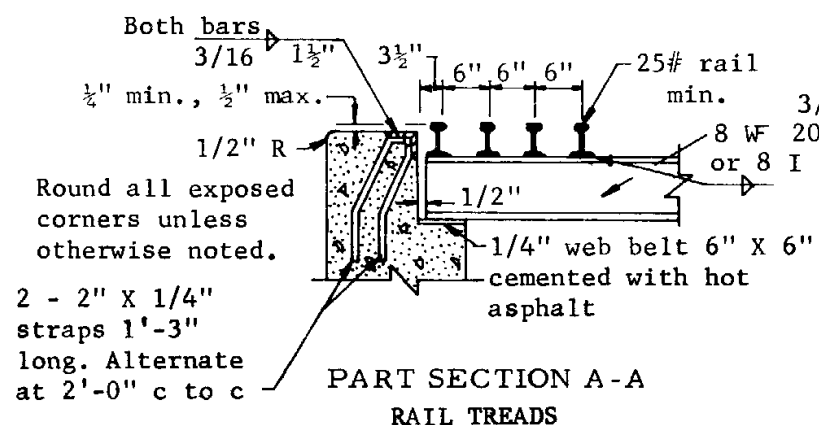
Approved two way self-closing latch



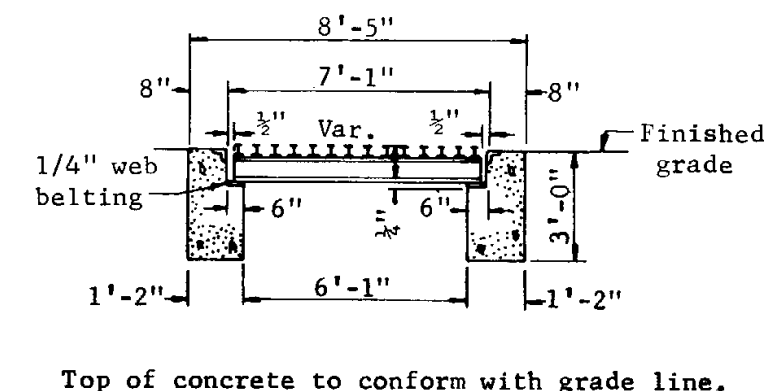
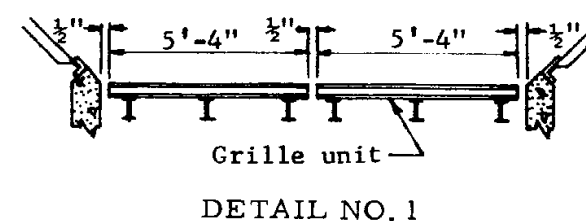
Note:
Fence posts, braces and Type 1 Gate as per Std. C-12.01.



HALF END VIEW HALF END SECTION
(Closed end) (Looking toward open end)



DETAIL OF WELDED GRILLE UNIT



MATERIAL LIST	Req'd.	
Fabricated L	2	3" X 3" X 3/8" X 10'-9 1/2"
Posts, for fence or gate	3	Same as Std. C-12.01 except as noted.
Bolts, with nut & washers	2	3/4" X 5" straight
Bolts, with nut & washers	4	3/4" X 1'-2", 45° bend mid point (anchor bolts)
Gate, with hinges & latch	1	Type 1 Gate for 14' opening, see Detail
Reinforcing bars	4	#4 bars X 8'-2" straight, aggregate weight, 22 lbs.
Reinforcing bars	8	#4 bars X 2'-10" straight, aggregate weight, 15 lbs.
Reinforcing bars	6	#4 bars X 11'-9" straight, aggregate weight, 47 lbs.
Std. welded grille unit	2	Approximate weight 2200 lbs.
Welded angle end frame	2	Approximate weight 560 lbs.
Web belting, grille shims	12	6" X 6" X 1/4"
Concrete	-	Class A. Total cubic yards 3.96 incl's setting 3 posts.

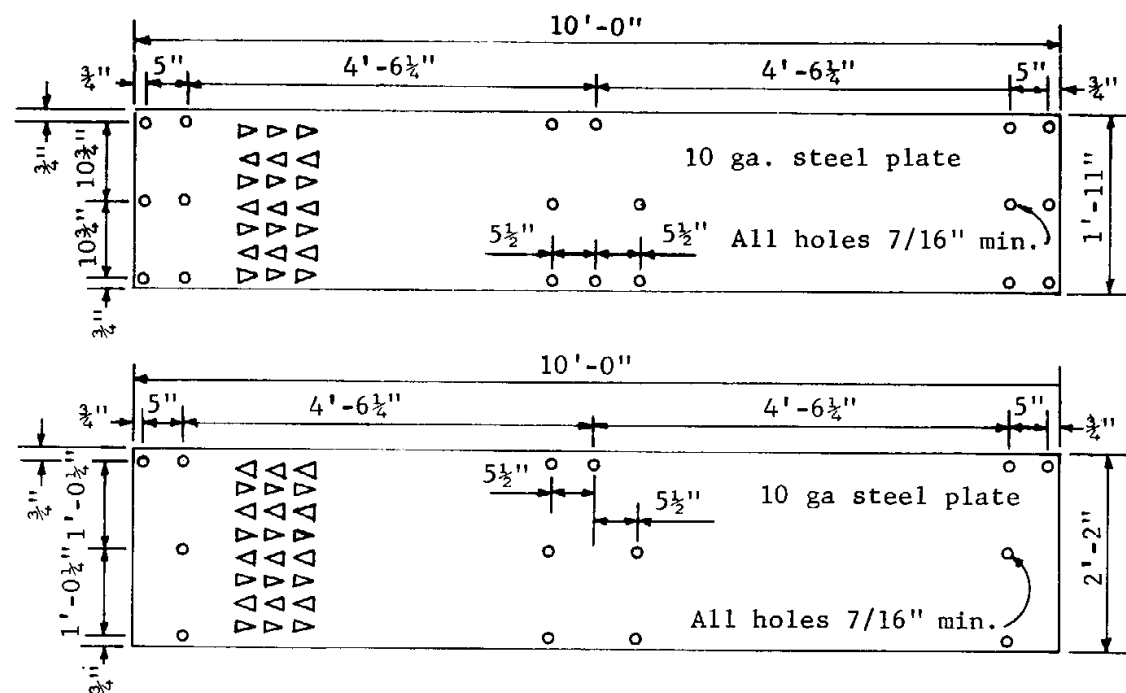
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

CATTLE GUARD - RANCH
FOR SIDEROAD ONLY

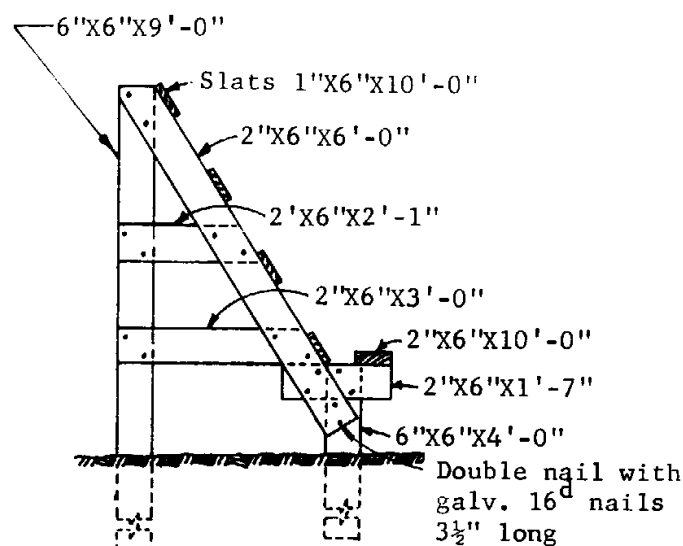
Drawn L.D. 5-54
Traced S.L.T. 8-67
Checked J.P.O. 990 5-68
Approved Engr. Plans *[Signature]* 5-68

Drawing No.
C-II.02

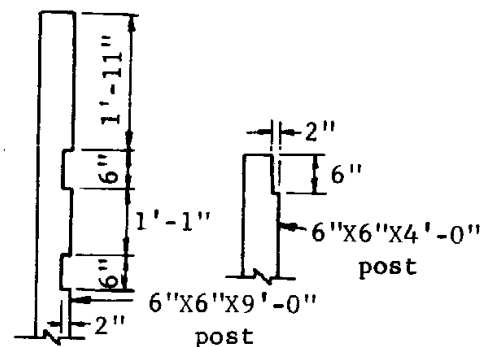
Rev



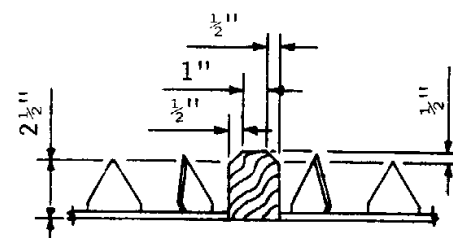
PLAN - 23" & 26" CATTLE GUARD PLATE



END FRAME TIMBER SIZES



END FRAME POST NOTCH DETAIL



DETAIL-2" X 3" TIMBER BETWEEN ADJACENT PLATES

Fasten down with
3 - 3/8" X 7" lag
screws each piece

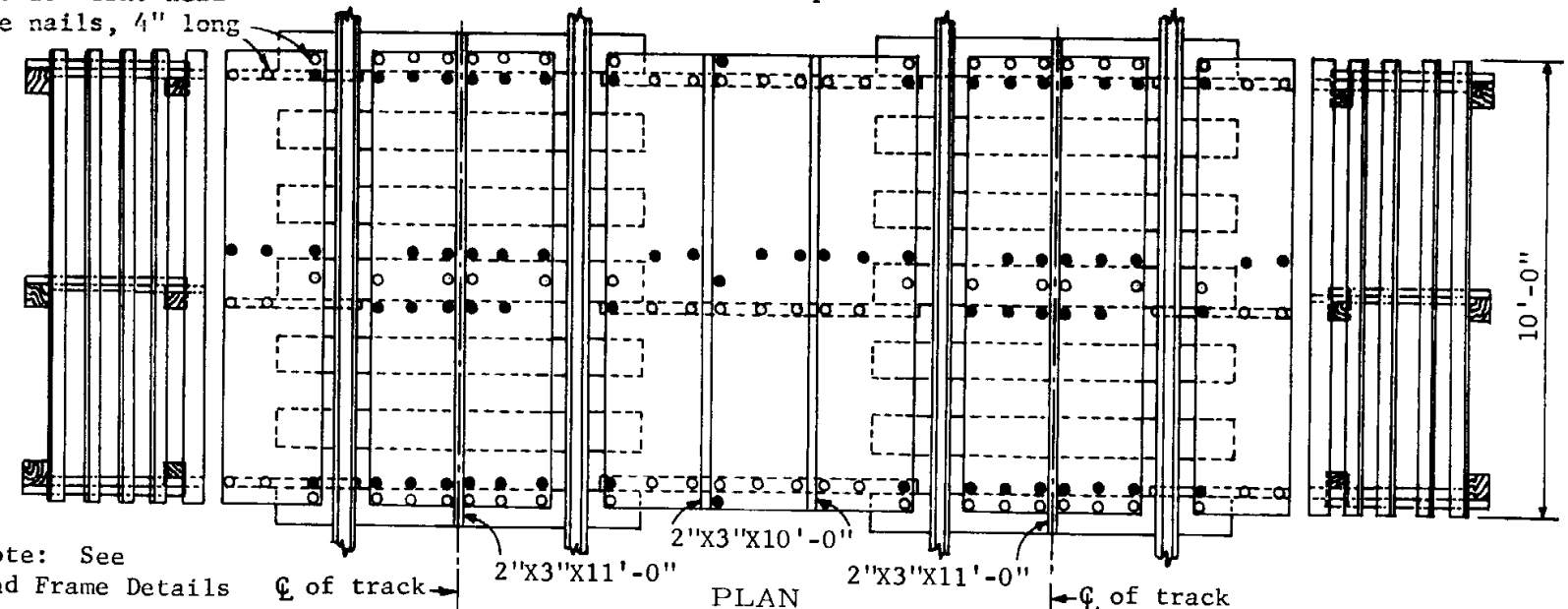
GENERAL NOTES

The 2" X 6" & 3" X 6" timbers that are fastened to the ties and the 6" X 6" posts shall be pressure treated, rough and unpainted. The remaining timber shall be given one coat of No. 7 and one coat of No. 8 paint.

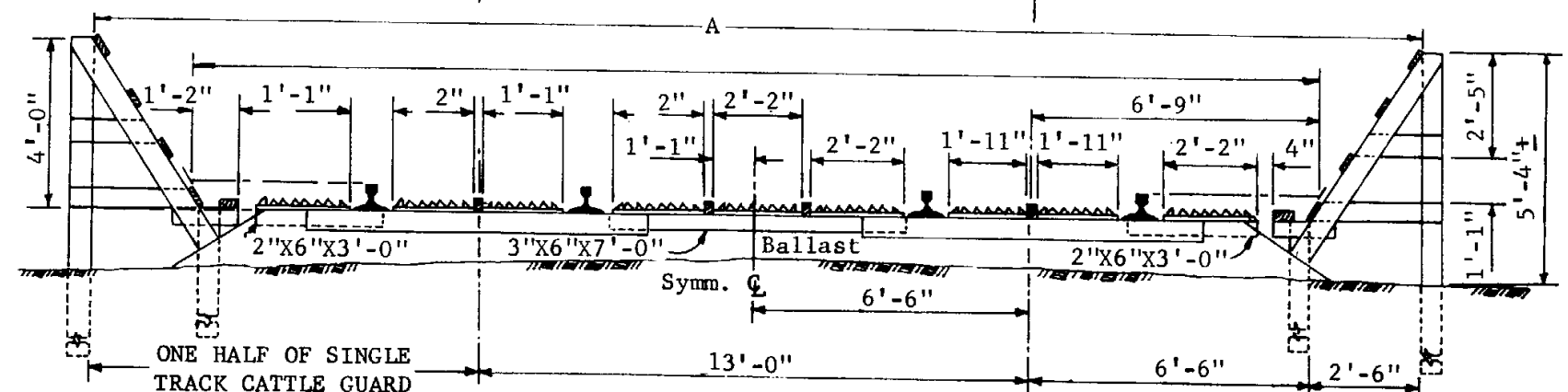
The metal plates shall be furnished with the manufacturer's shop coat of paint or shall be given one coat of No. 1 paint.

Galv. 20^d csk. head
hinge nails, 4" long

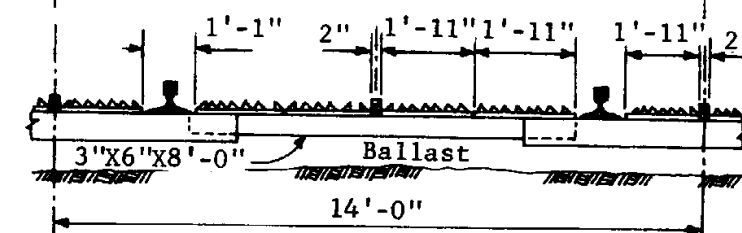
Nails not required in holes thus: •



Note: See
End Frame Details



ELEVATION



ELEVATION

DIMENSIONS	A	B
Single Track	18'-0"	13'-6"
13' Track Centers	31'-0"	26'-6"
14' Track Centers	32'-0"	27'-6"

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

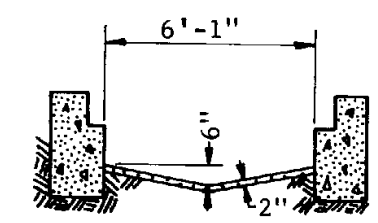
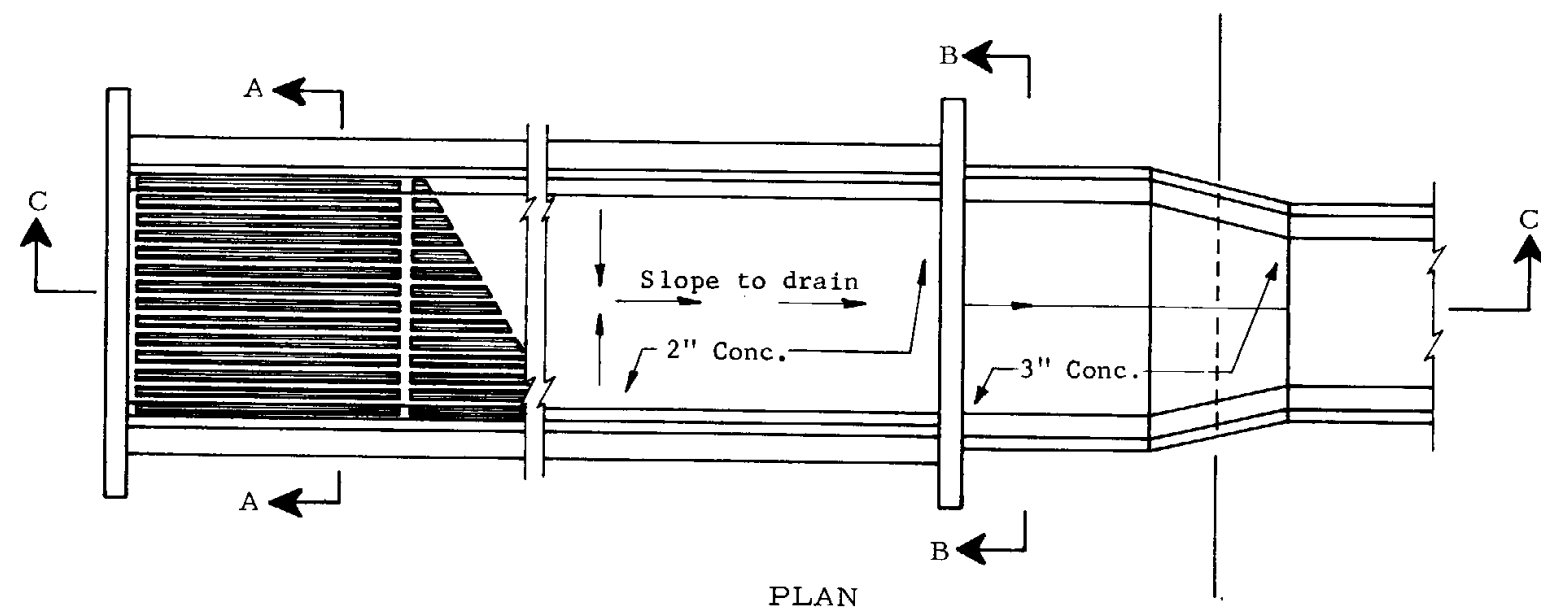
CATTLE GUARD
RAILROAD

Drawn D.G. 3-67
Traced S.L.T. 4-67
Checked J.P.O. 8PD 5-68
Approved Engr. Plans H. H. H. 5-68

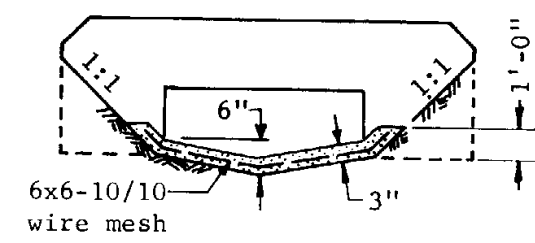
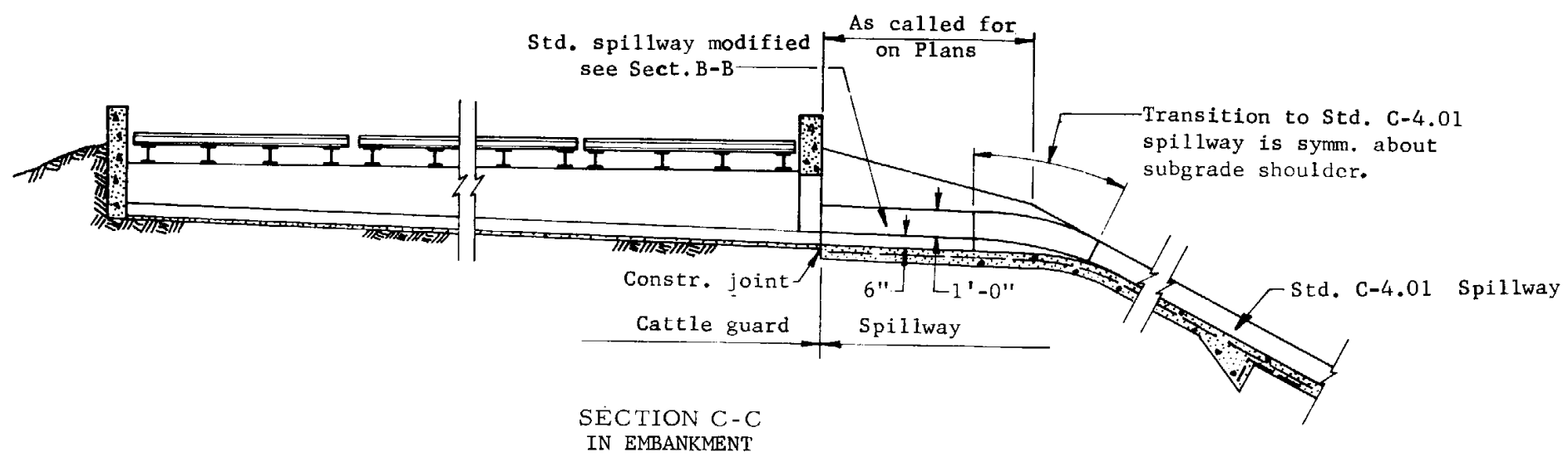
Drawing No.

C-II.03

Rev

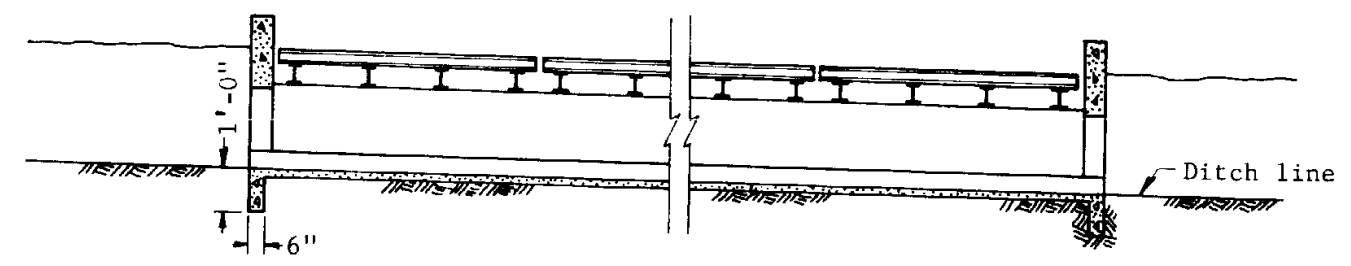


SECTION A-A



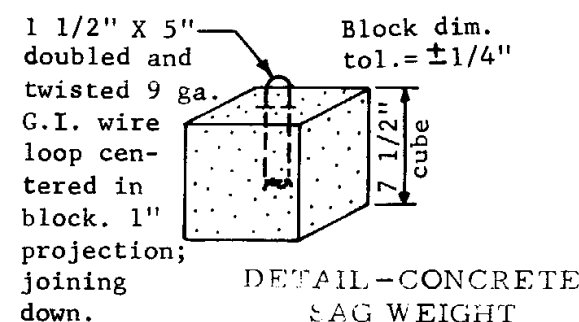
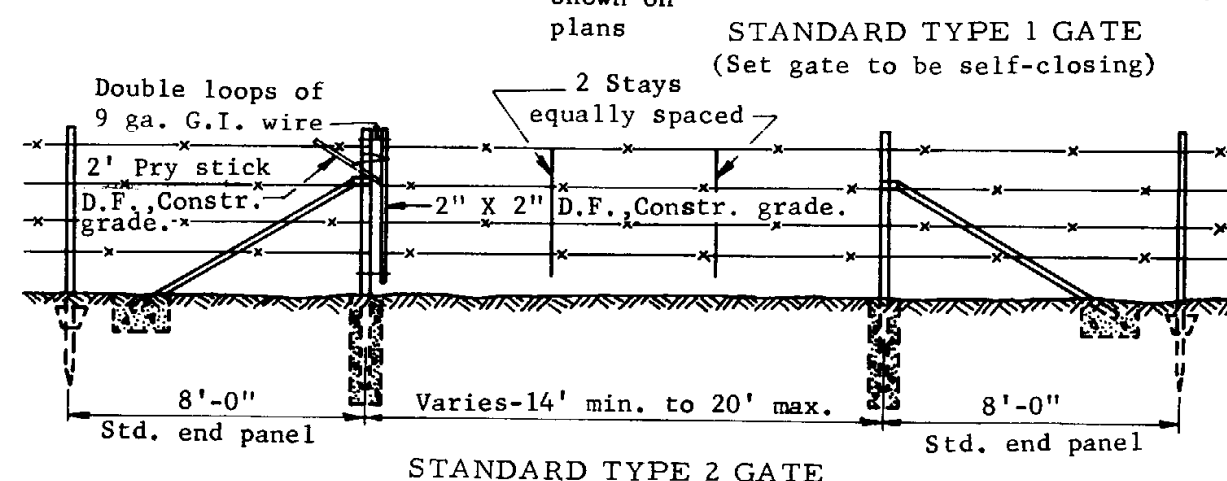
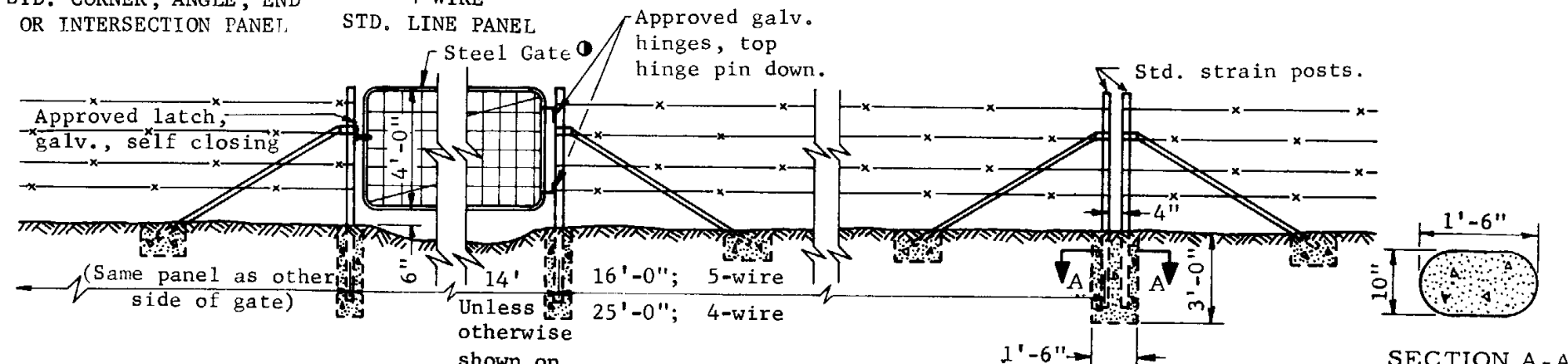
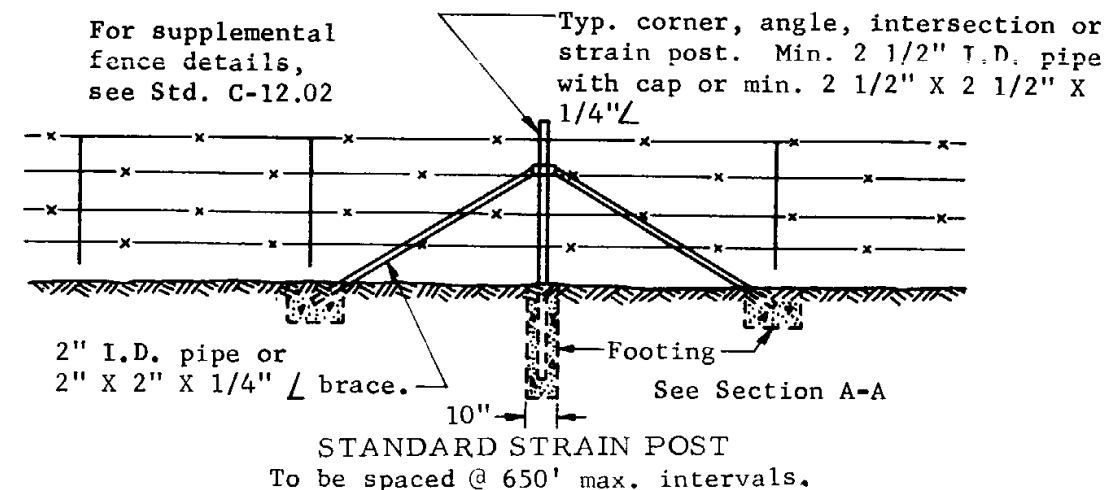
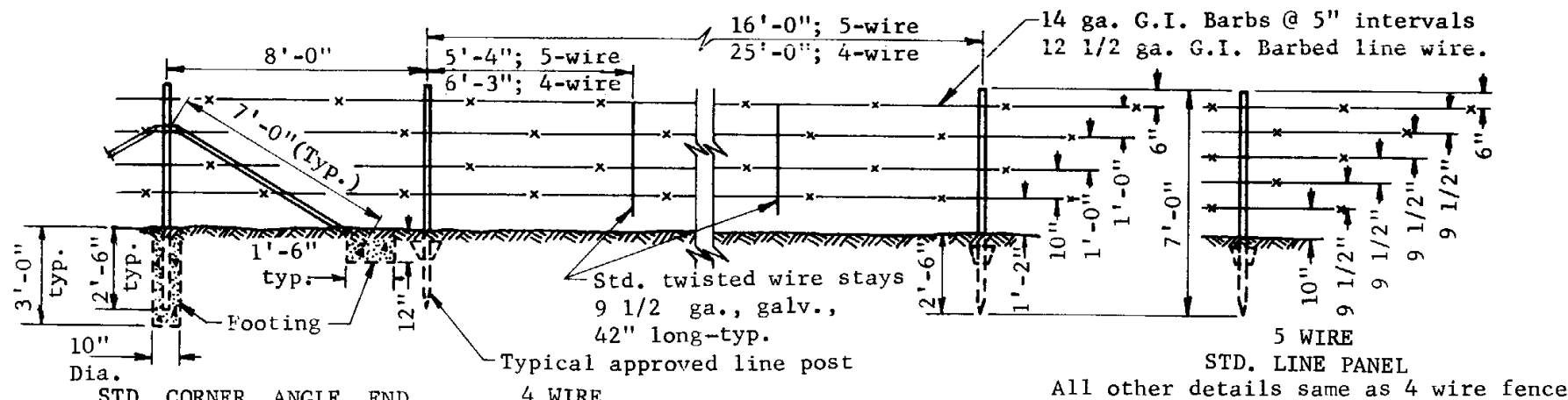
SECTION B-B

GENERAL NOTES
 For all other cattle guard details, see Std. C-11.01.
 This standard shall be used in embankment or where highly errodable soil is found.
 All concrete shall be Class A..



SECTION C-C
 WHERE USED FOR THRU DRAINAGE-
 CATTLE GUARD OPEN BOTH ENDS

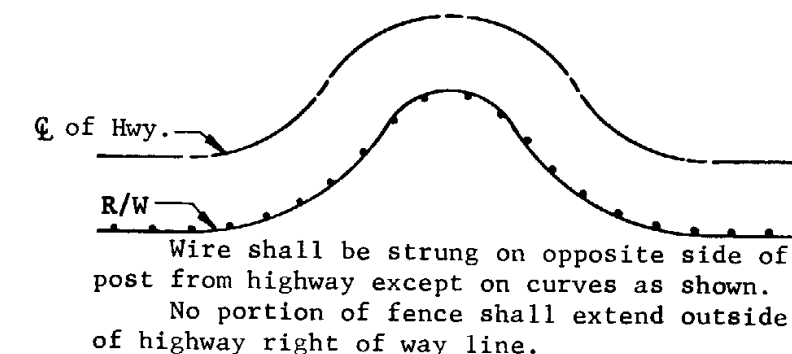
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CATTLE GUARD DRAINAGE			
Drawn	M.C.T. 6-15-65	Drawing No. C-11.04	
Traced	R.A.F. 5-5-67		
Checked	J.P.O. 990 5-68		
Approved Engr. Plans	<i>[Signature]</i> 5-68		



Note:
When tubular post hangers and/or latches are used, hangers and/or latches shall be drilled for a single 3/32" Ø min. drive pin to prevent rotation of the hangers and latches.

TYPICAL STEEL LINE POST SECTIONS

1 3/8" Ø tubing - 2 vert. braces. Mesh □, Δ, ◇ - 11 ga. line wires - 12 1/2 ga. crosswires. 1 - adjustable diagonal guy. Fully galvanized.



GENERAL NOTES

Posts and braces shall be green in color. Posts shall have white top. Wood parts of Type 2 gate shall be unpainted.

Line posts shall be "T", "U", "Rail", "Hat", or similar production sections except "Ells" or "Angles"; shall weigh, exclusive of anchor, a min. of 1.3 #/ft. and shall be punched, knobbed or corrugated to hold wire firmly in position. Clamps of min. 11 ga. galv. wire shall be used to attach fence. Punched, lug type fasteners are not permitted.

Where anchor is omitted or post hole is drilled, posts must be set in concrete.

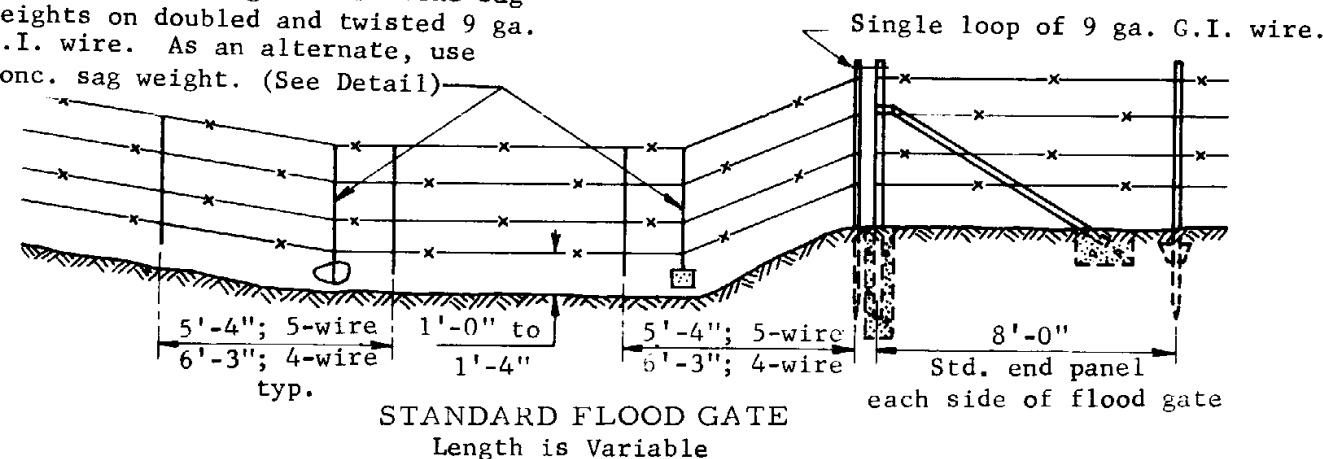
There may be a max. of two splices between strain posts but not on the same wire and no splice shall be placed within 100' of a strain, corner or gate post.

Post spacing shall be measured along top wire.

Angle is any deflection greater than 14°.

All concrete shall be Class A.

Where needed, hang 30-35# stone sag weights on doubled and twisted 9 ga. G.I. wire. As an alternate, use conc. sag weight. (See Detail)

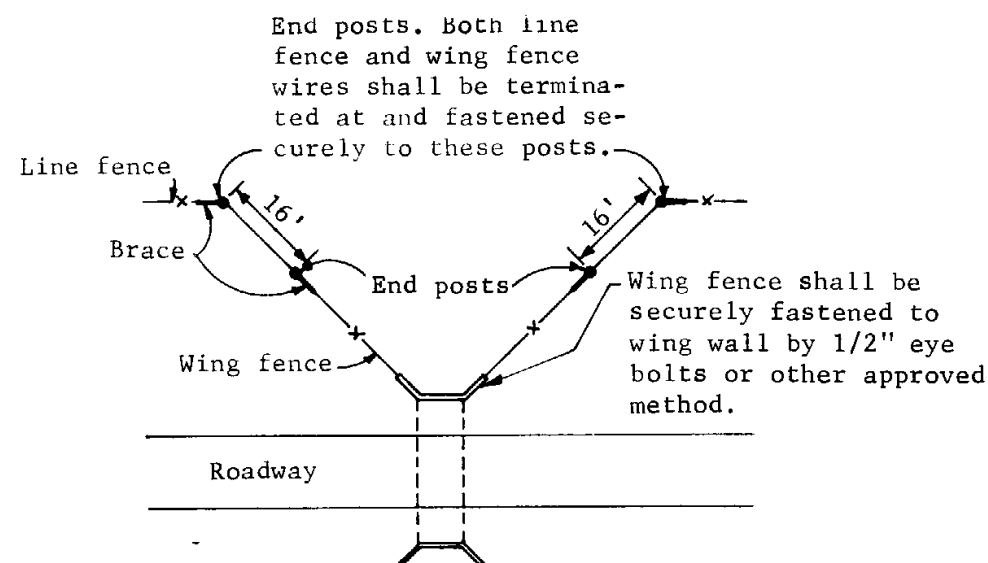


ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

LINE FENCE AND GATES
STEEL POSTS

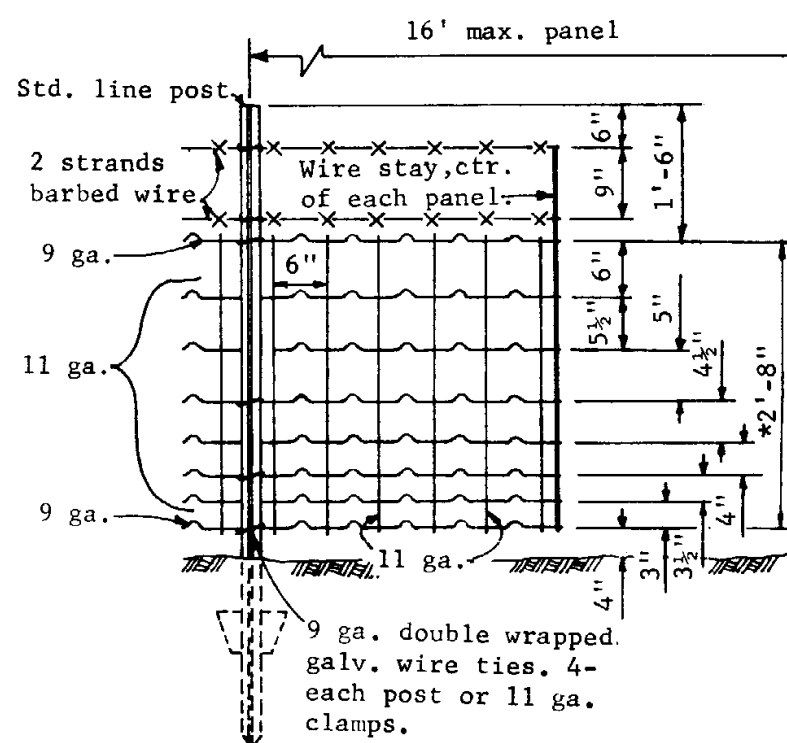
Drawn	K. S. 6-1938	Drawing No. C-12.01
Traced	R.A.F 3-7-67	
Checked	J.P.O. 8PD 5-68	
Approved Engr. Plans	J. Heidecker 5-68	

Rev



WING FENCE DETAIL

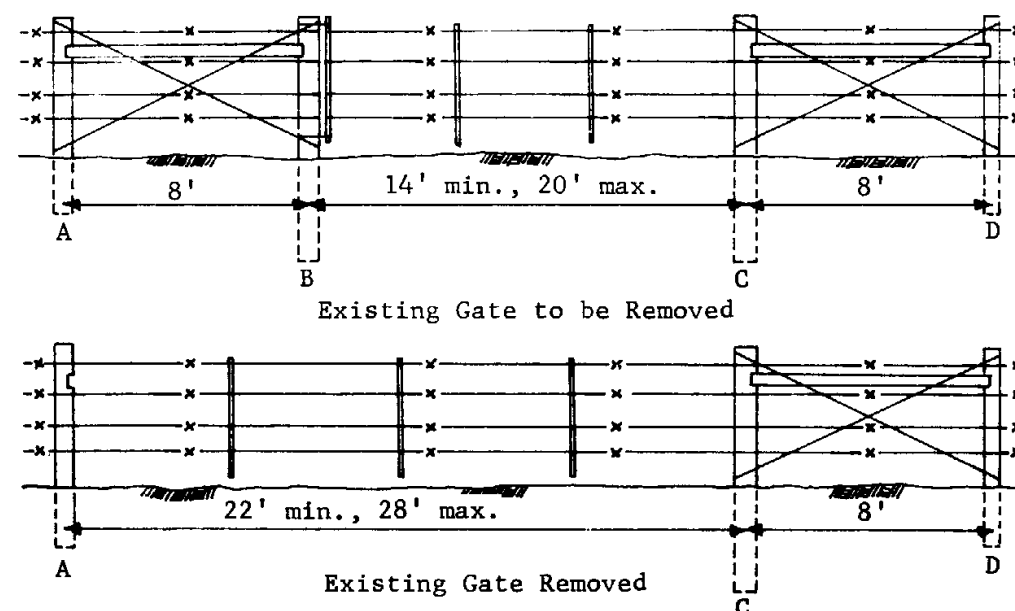
This detail shall be used where wing fences are called for on plans.



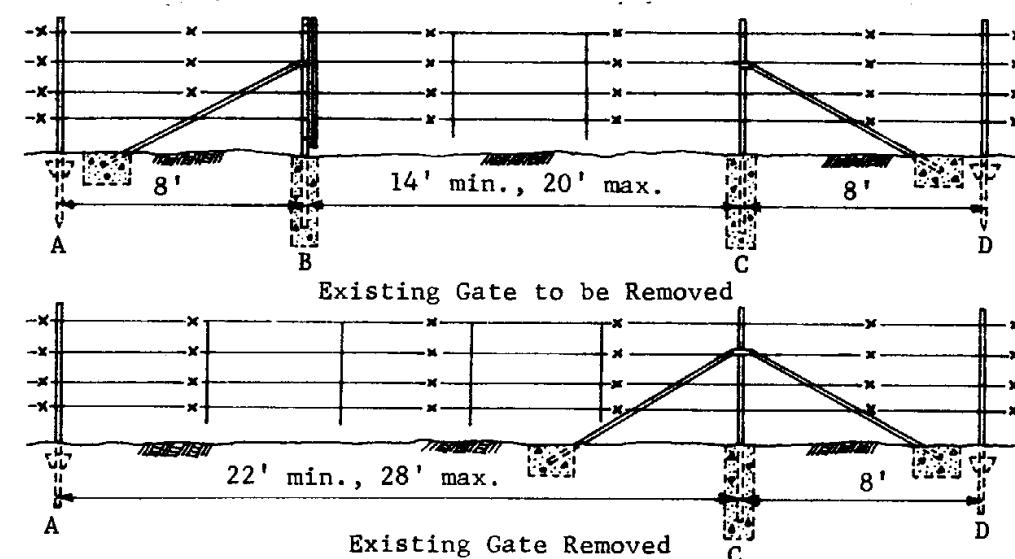
STOCK FENCE

*Rectangular mesh galv. stock fence.

WOOD POST FENCE-TYPE 1 or 2 GATE-4 or 5 WIRE

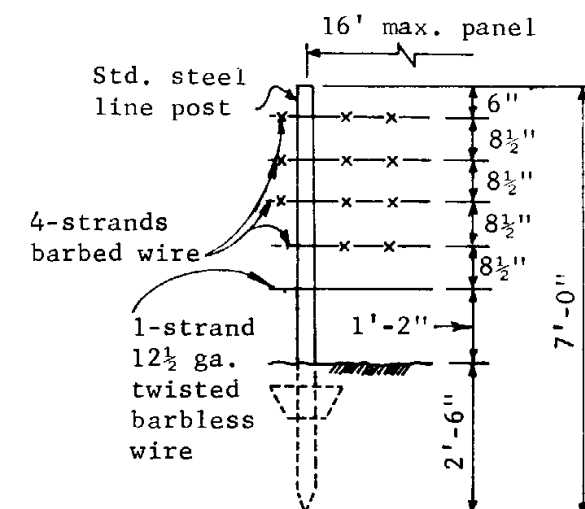


STD. C-12.01 FENCE-TYPE 1 or 2 GATE-4 or 5 WIRE



DETAIL FOR REMOVING EXISTING LINE GATES

Procedure: Remove gate and hardware and wire between posts A and C. Install new second brace at post C (Std. C-12.01 fence only). Stretch new wire between posts A and C. Remove post B and brace.
(Approved salvaged wire may be used.)
Staples for wood posts shall be 1 1/2" galvanized and fabricated from 9 gauge wire.



Drawn for 5-wire

GAME FENCE

4-wire game fence shall be constructed using standard 4-wire line fence spacing and substituting 12 1/2 ga. twisted, barbed wire for the bottom strand.

GENERAL NOTES

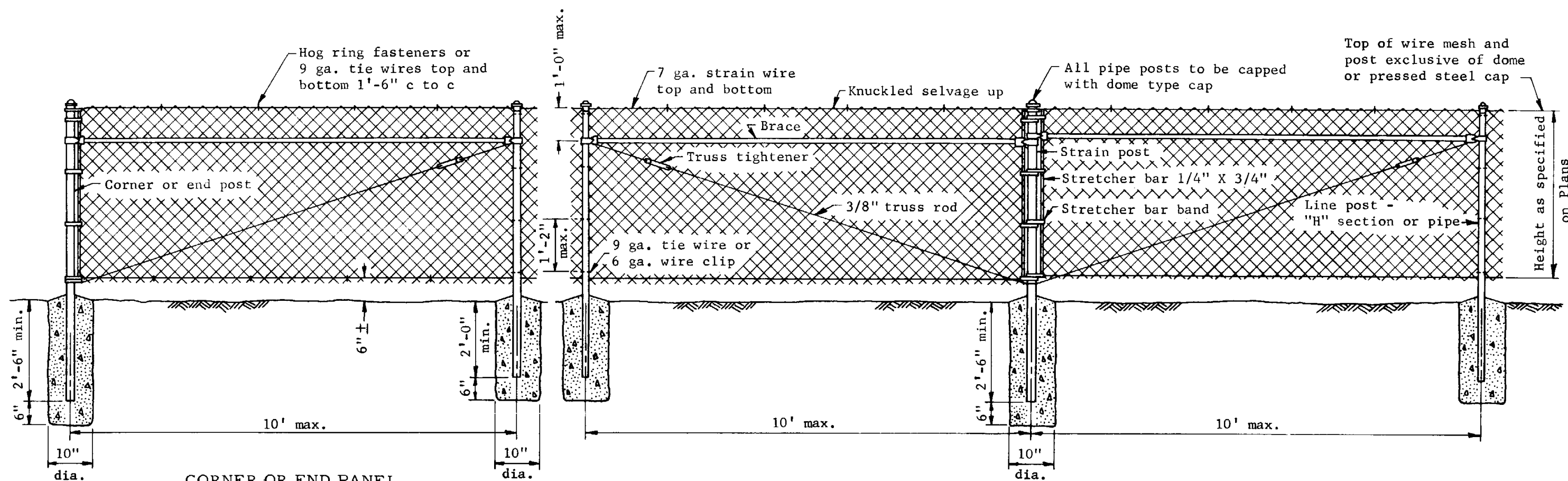
For any details not shown on this sheet, refer to Stds. C-12.01.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

SUPPLEMENTAL FENCE
DETAILS

Drawn	LOM, KS, DC-4-60	Drawing No. C-12.02
Traced	D.G. 3-67	
Checked	J.P.O. 880 5-68	
Approved Engr. Plans	8/11/68 5-68	

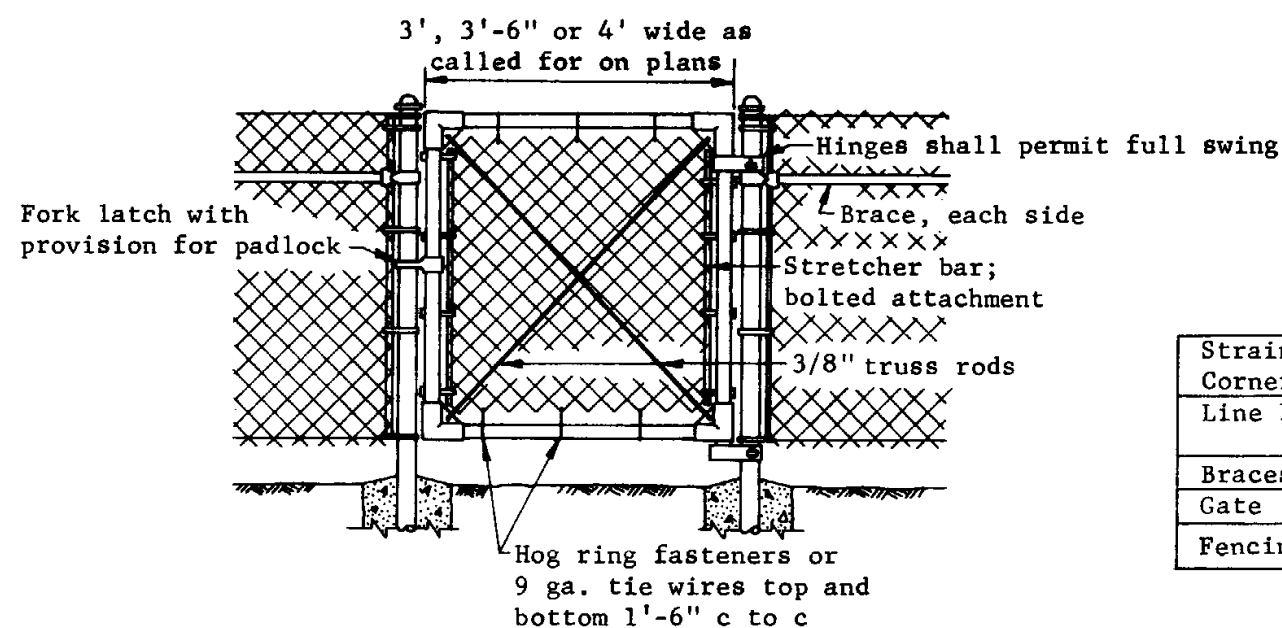
Rev



To be spaced at 500' maximum intervals

GENERAL NOTES

All concrete shall be Class A.
 Gates shall be of welded or malleable cast or pressed steel fitting construction.
 Fittings not specifically detailed shall be of approved heavy duty design.
 "H" Section posts shall be capped with pressed steel top.



Strain, End & Corner Posts	2" I.D. Nominal size pipe
Line Posts	1 1/2" I.D. Nominal size pipe "H" Sec. 1 7/8" X 1 5/8" Nominal size
Braces	1 1/4" I.D. Nominal size pipe
Gate	1 1/2" I.D. Nominal size pipe
Fencing	9 ga., 2" mesh fabricated wire

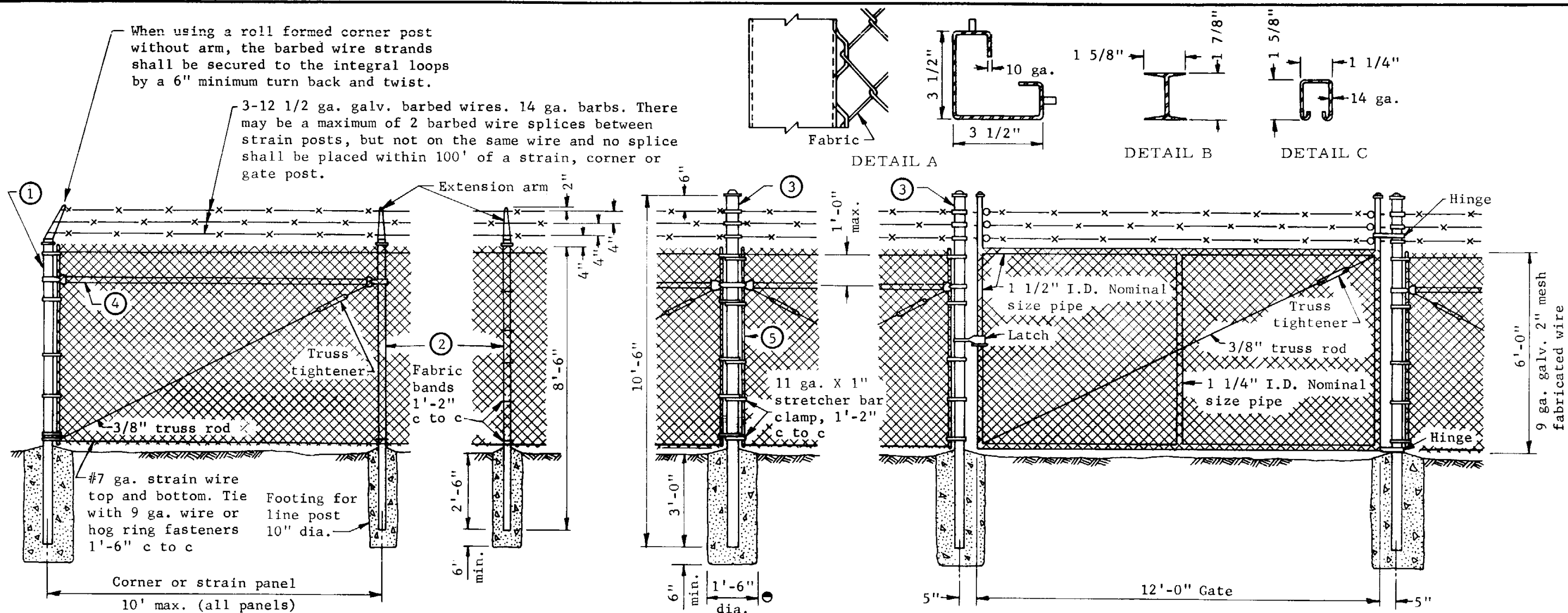
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

Rev

FENCE CHAIN LINK

Drawn L.O.M. 2-58
 Traced R.A.F. 11-67
 Checked J.P.O. 970 5-68
 Approved Engr. Plans *[Signature]* 5-68

Drawing No.
C-12.03



● Footing for Strain, End, Corner and Gate Posts

Note: For Walk Gate, see Std. C-12.03.

Fencing shall be 9 ga., 2" mesh, fabricated wire.

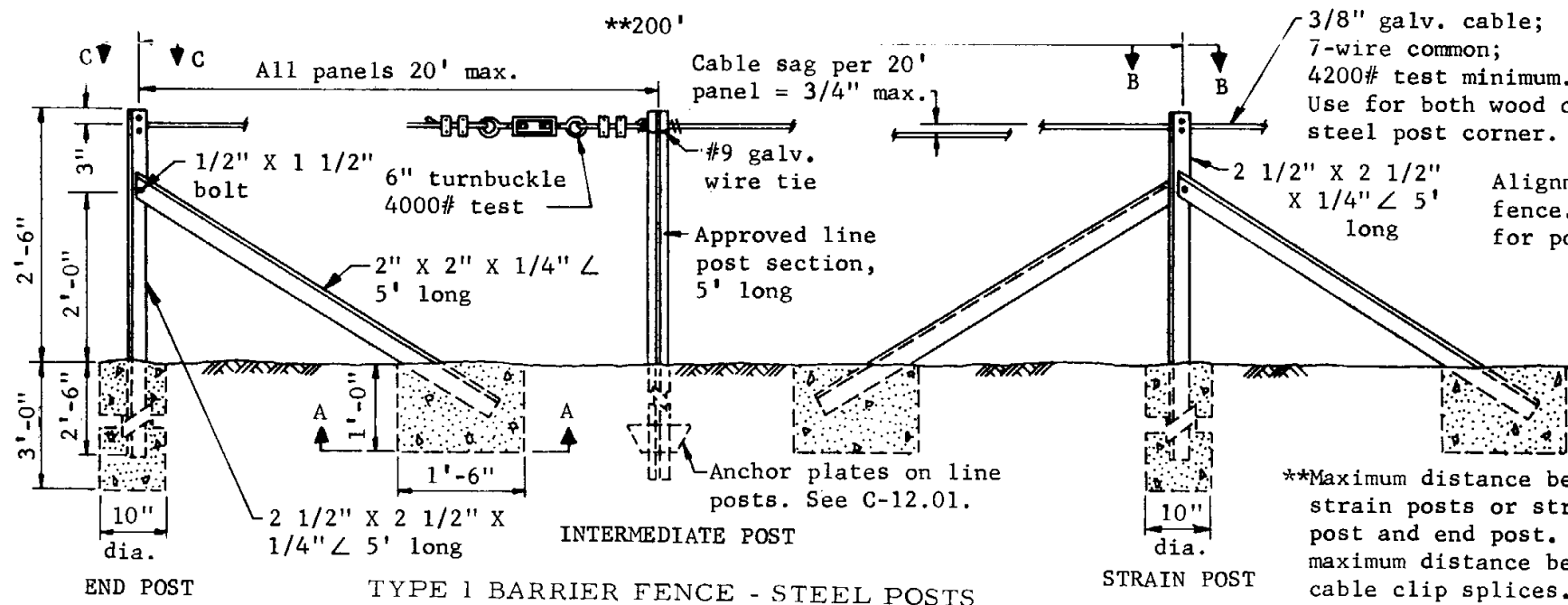
Fence Using Pipe Members		
Member	Size	Lgth.
① Corner post	3 1/2" I.D. nominal pipe size	9'-0"
② Line post	1 1/2" I.D. nominal pipe size	8'-6"
③ Strain or gate post	3 1/2" I.D. nominal pipe size	10'-6"
④ Brace	1 1/4" I.D. nominal pipe size	as req'd.
⑤ Stretcher bar	1/4" x 3/4" flat	6'-2"
Fence Using Roll Formed Members		
① Corner post	5.14# /ft. section with integral fabric loops per Detail A or equal	9'-0"
② Line post	2.72# /ft. section per Detail B or equal	8'-6"
③ Strain or gate post	3 1/2" I.D. nominal pipe size	10'-6"
④ Brace	1.35# /ft. section per Detail C or equal	as req'd.
⑤ *Stretcher bar	1/4" X 3/4" flat	6'-2"

* Not used with corner post having integral fabric loops. (See Detail A)

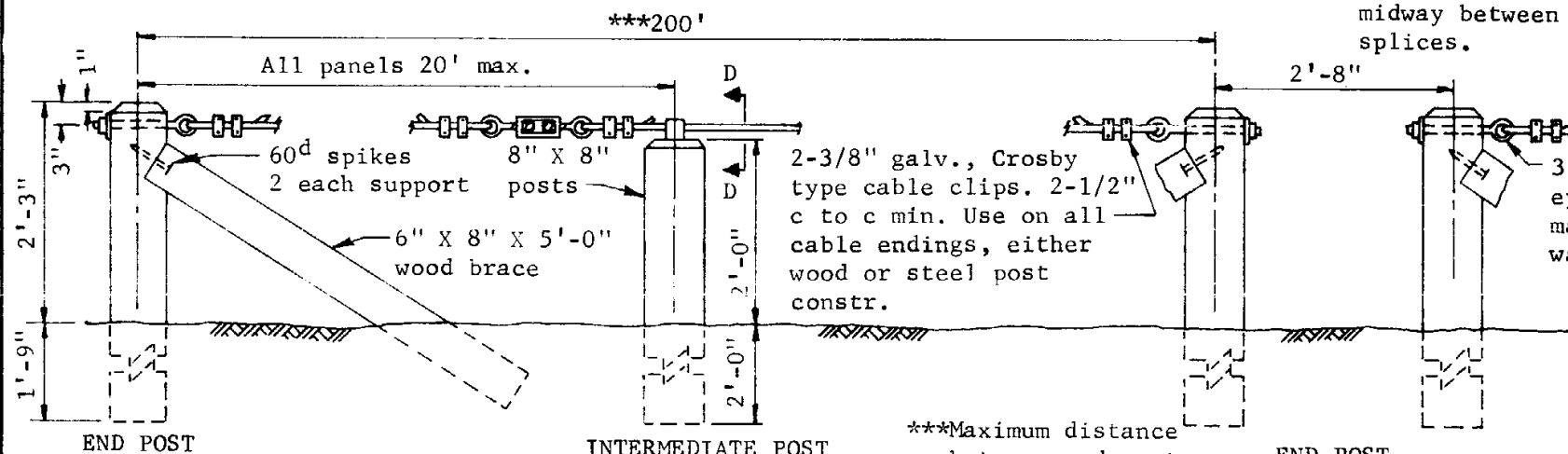
GENERAL NOTES

All concrete shall be Class A.
 Gates shall be of welded or malleable cast or pressed steel fitting construction.
 Fittings not specifically detailed shall be of approved heavy duty design.
 Strain posts shall be spaced at 500' maximum intervals and both corner and strain posts shall have strain panels each side.
 All pipe posts shall be capped.

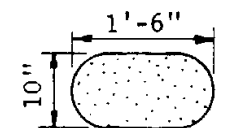
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
FENCE-INDUSTRIAL TYPE, FABRICATED WIRE			
Drawn	L.O.M. 3-65	Drawing No. C-12.04	
Traced	R.A.F. 1-68		
Checked	J.P.O. 8PO 5-68		
Approved Engr. Plans	<i>[Signature]</i> 5-68		



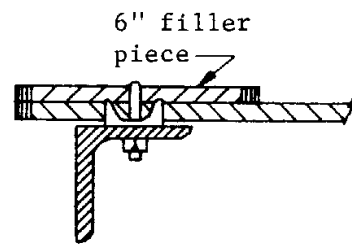
TYPE 1 BARRIER FENCE - STEEL POSTS



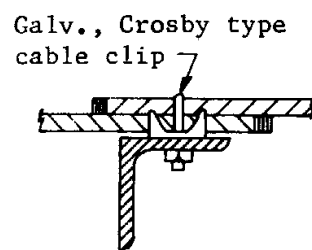
TYPE 2 BARRIER FENCE
WOOD POSTS



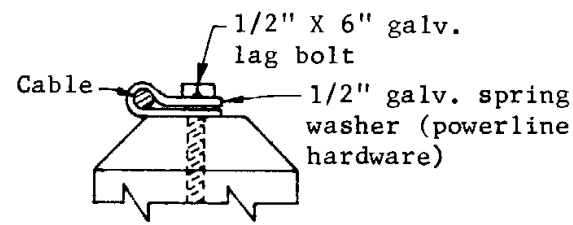
SECTION A-A



SECTION C-C



SECTION B-B



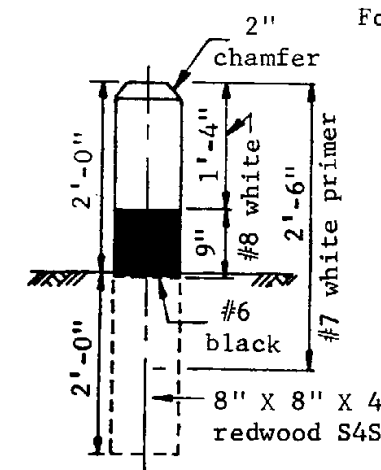
SECTION D-D

***Maximum distance between end post and cable splices. Place turnbuckle approximately midway between end posts.

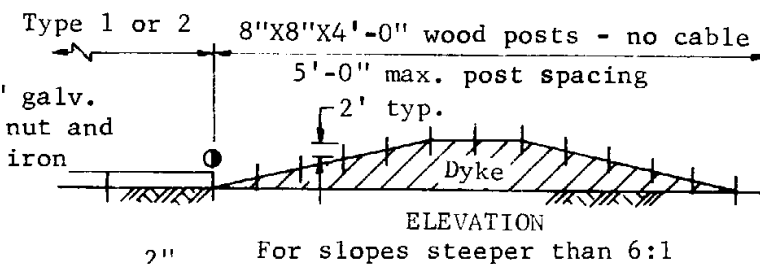
END POST

GENERAL NOTES

All concrete shall be Class A.
Wood posts for barrier fence shall be rough, pressure treated.
Steel posts for barrier fence shall be painted green with white tops.
Barrier posts shall be S4S redwood, untreated.
All cable ends shall be wrapped with galvanized tie wire in accordance with the cable manufacturer's recommendations.
Barrier fence shall be used only to prevent crossings between roadways and shall not be used where guard rail is required or where physical barriers are present.

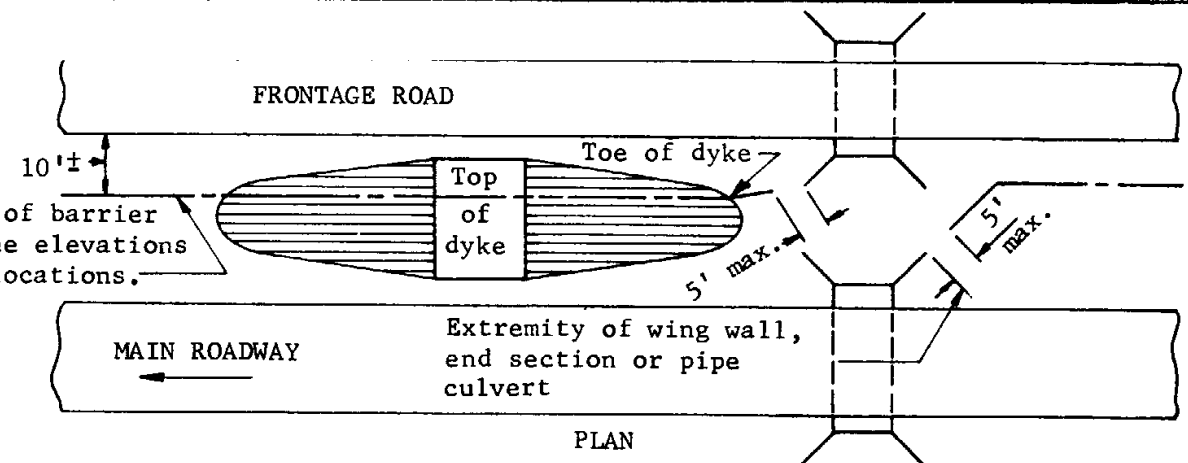


BARRIER POST

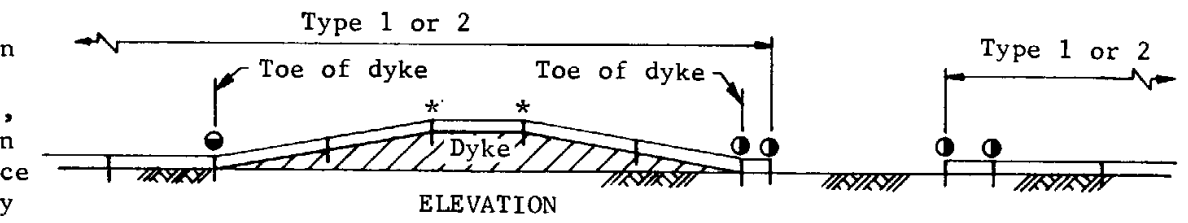


For slopes steeper than 6:1

- * Required location of line post
- Required location of end post
- Required location of strain post



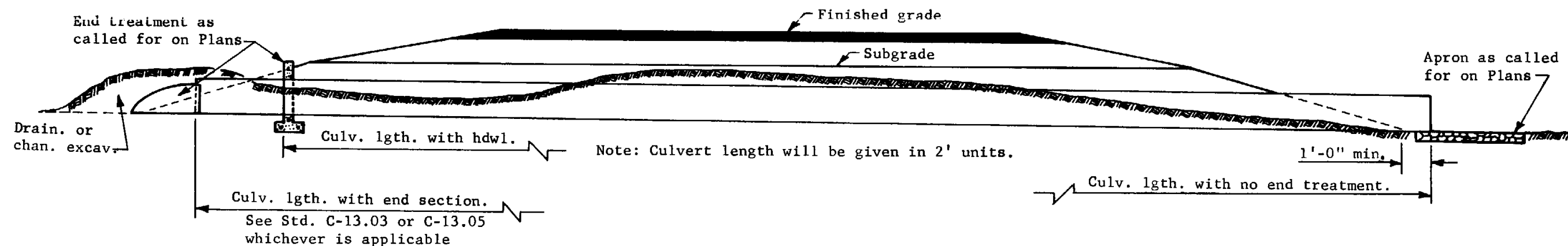
PLAN



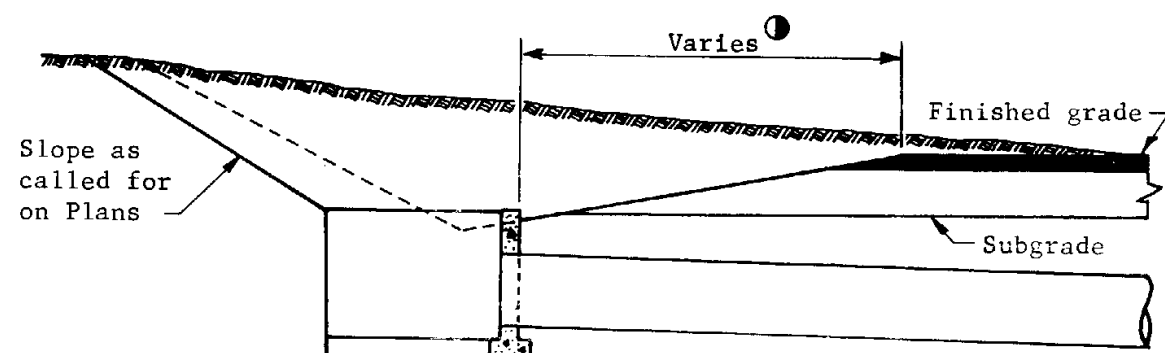
ELEVATION

For Type 1 or Type 2 - 6:1 slope only

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
BARRIER FENCE AND BARRIER POST			
Drawn	D.G.	10-66	Drawing No. C-12.05
Traced	S.L.T.	10-67	
Checked	J.P.O.	<i>920</i> 5-68	
Approved Engr. Plans	<i>J. H. H. 5-68</i>		



EMBANKMENT INSTALLATION



CUT INSTALLATION

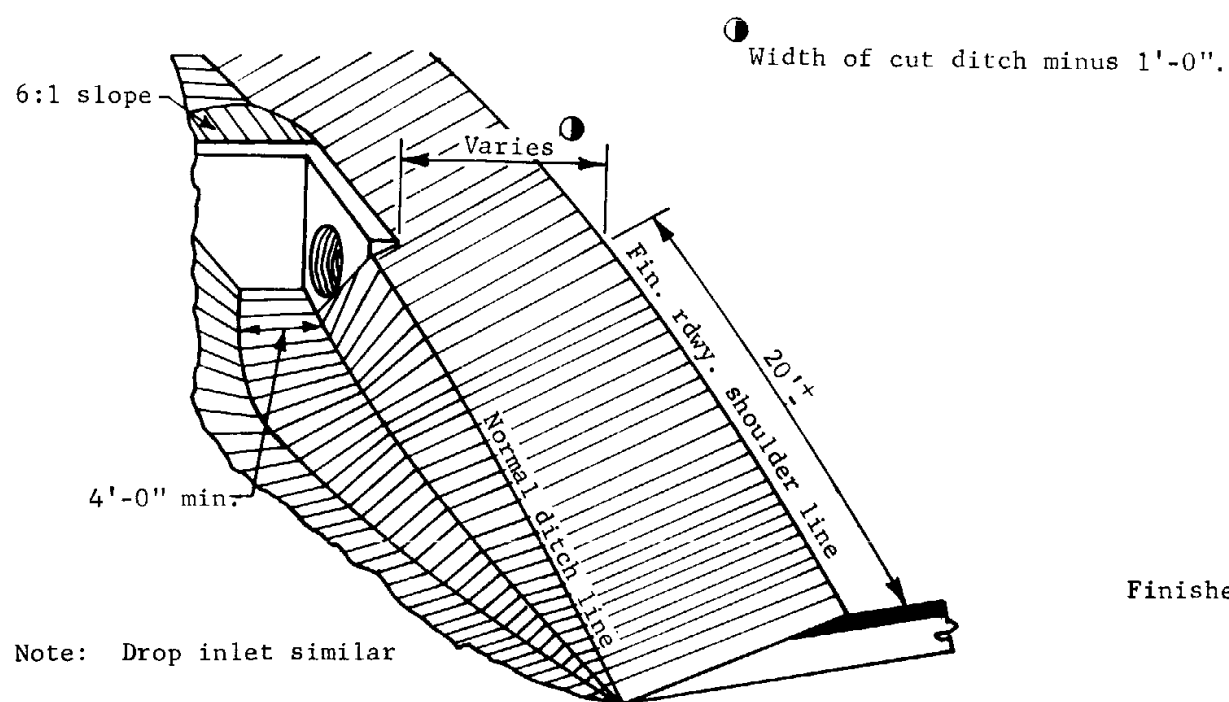
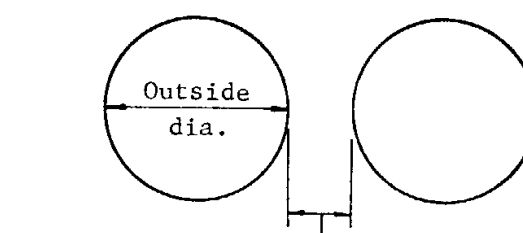
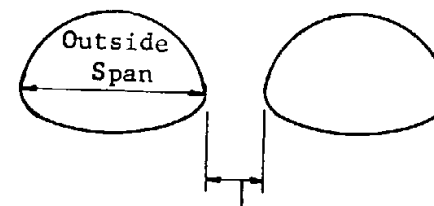


FIGURE A



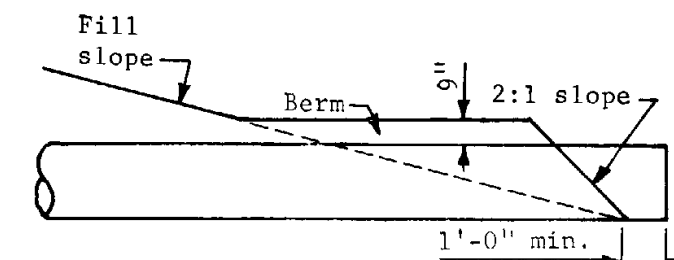
Diameter	*Minimum space between pipes
12" to 24"	1'-0"
30" to 66"	One-half diameter of pipe
72" to 84"	3'-0"

*When headwalls are used, space as per headwall standard.

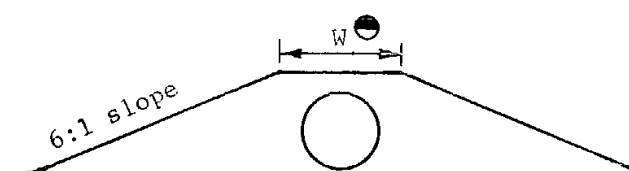


Span	Minimum space between pipe arches
18" to 36"	1'-0"
43" to 72"	One-third span of pipe arch

SPACING FOR MULTIPLE INSTALLATIONS



Side Elevation



End Elevation

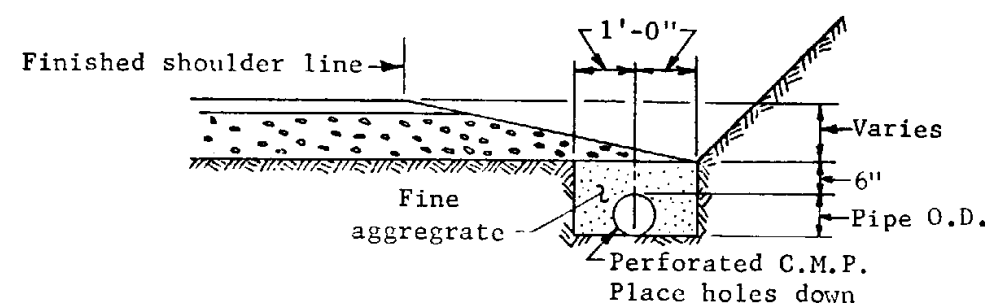
● W for outlet end = 4' + pipe dia.

Berm shall be constructed as noted on plans.

GENERAL NOTES

Additional excavation shall be required, as shown in Figure A, when headwalls are located in a cut ditch.

Headwall shall not extend more than 3" above the embankment slope and in no case above the shoulder elevation.



PERFORATED C.M.P. INSTALLATION

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

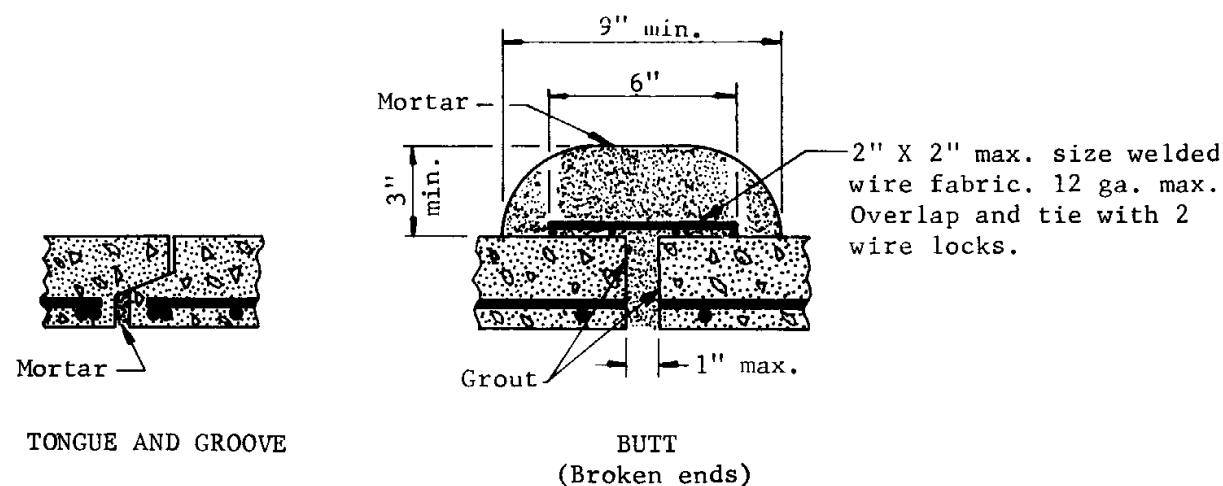
PIPE CULVERT INSTALLATION

Drawn D.G. 3-68
Traced D.G. 3-68
Checked J.P.O. 8/0 5-68
Approved Engr. Plans H. Heideker 5-68

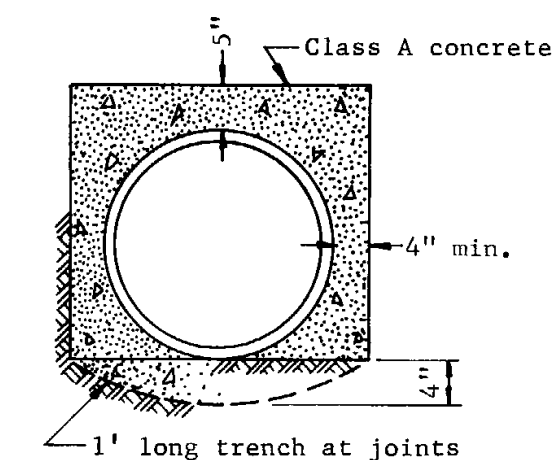
Drawing No.

C-13.01

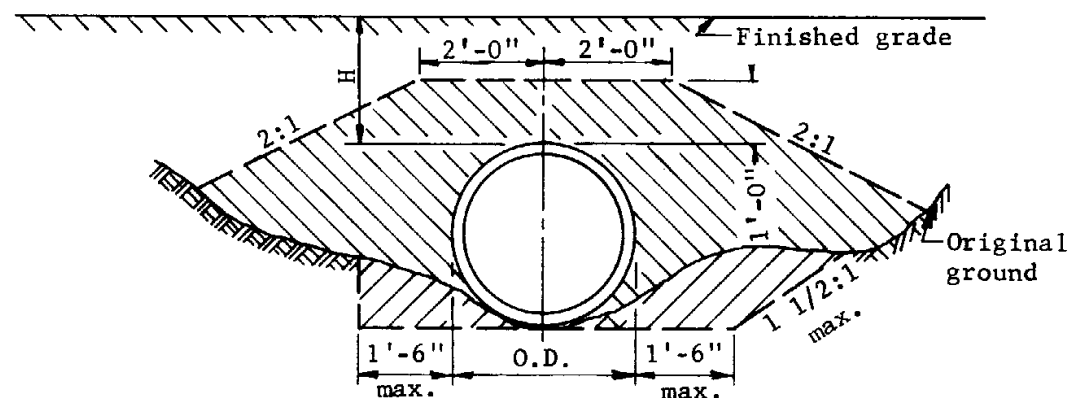
Rev



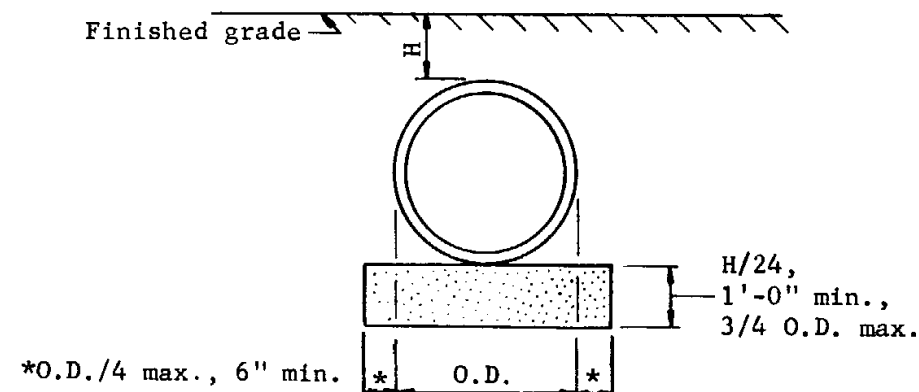
MORTAR JOINTS



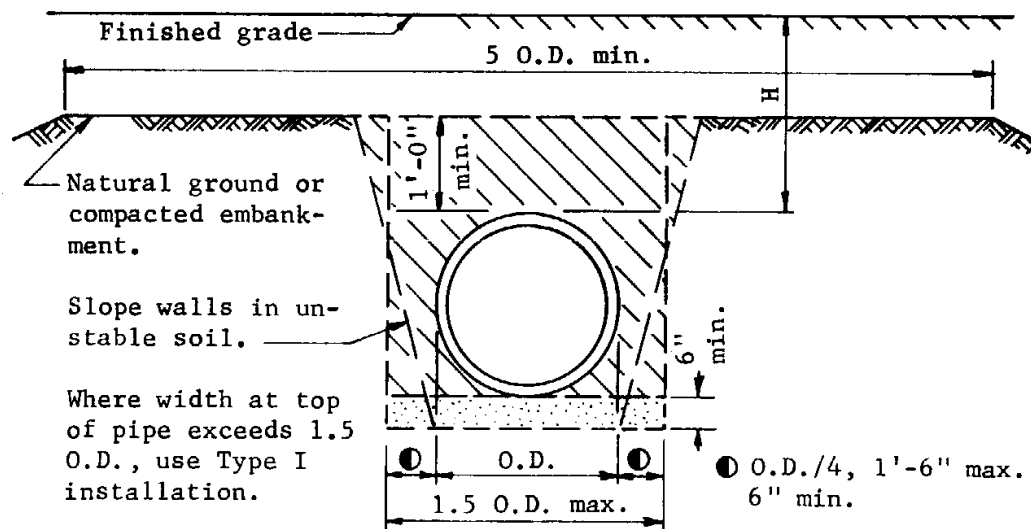
CONCRETE ENCASEMENT



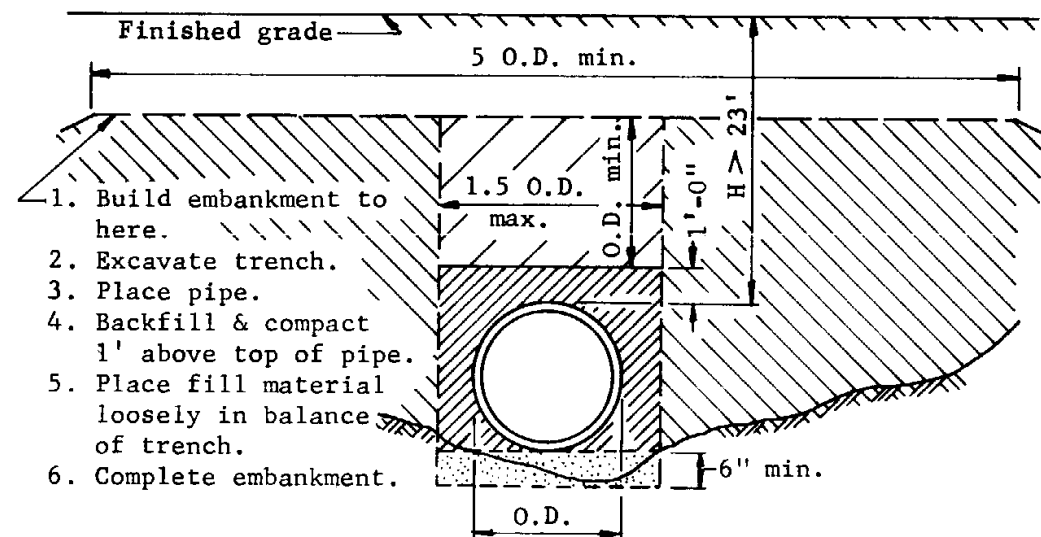
TYPE 1 - POSITIVE PROJECTING



SOLID ROCK OR OTHER UNYIELDING MATERIAL



TYPE 2 - NEGATIVE PROJECTING



TYPE 3 - IMPERFECT TRENCH

GENERAL NOTES

Rubber gasketed joints shall be used on irrigation and storm sewer lines unless mortar joints are specified.

Cross drains with tongue and groove joints will not require external mortar bands.

For minimum cover and maximum fill heights on concrete pipes, refer to Std. C-13.03.

In the type I placement the contractor may elect to place the embankment first and then excavate a trench for the pipe - No Pay Item.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

REINFORCED CONCRETE
PIPE PLACEMENT

Drawn	R.E.W.	3-58
Traced	S.L.T.	7-67
Checked	J.P.O.	9PO 5-68
Approved	Engr. Plans <i>[Signature]</i> 5-68	

Drawing No.
C-13.02

Rev

HORIZONTAL ELLIPTICAL PIPE										VERTICAL ELLIPTICAL PIPE																		
Size	Area of Open'g	HE II			HE III			HE IV			Size	Area of Open'g	VE II			VE III			VE IV			VE V			VI			
		Crack D Load 1000			Crack D Load 1350			Crack D Load 2000					Crack D Load 1000			Crack D Load 1350			Crack D Load 2000			Crack D Load 3000			Crack D Load 4000			
		Min.	Type		Min.	Type		Min.	Type				Min.	Type		Min.	Type		Min.	Type		Min.	Type		Min.	Type		
(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)	(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)	(1)
14 x 23	1.8				2	13	20	1	20	NL	45 x 29	7.4	2	15	15	2	23	40	88	1	35	NL	NL	1	NL	NL	NL	NL
19 x 30	3.3				2	13	15	1	20	NL	49 x 32	8.8	2	15	15	2	18	30	78	1	28	NL	NL	1	NL	NL	NL	NL
22 x 34	4.1				2	13	15	1	20	40	53 x 34	10.2	2	15	15	2	18	25	70	1	27	NL	85	1	NL	NL	NL	NL
24 x 38	5.1	2	10	10	2	13	15	1	20	30	60 x 38	12.9	2	15	15	2	18	20	70	1	27	55	80	1	65	NL	NL	NL
27 x 42	6.3	2	10	10	2	13	13	1	20	25	68 x 43	16.6	2	15	15	2	18	20	70	1	27	40	80	1	50	NL	NL	NL
29 x 45	7.4	2	10	10	2	13	13	1	20	25	76 x 48	20.5	2	15	15	2	18	18	70	1	27	35	77	1	40	NL	NL	
32 x 49	8.8	2	10	10	1	13	13	1	20	22	83 x 53	24.8	2	15	15	2	18	18	70	1	27	30	77	1	35	NL	NL	
34 x 53	10.2	2	10	10	1	13	13	1	20	22	91 x 58	29.5	2	15	15	2	18	18	70	1	27	30	74					
38 x 60	12.9	2	10	10	1	13	13	1	20	22	98 x 63	34.6	2	15	15	2	18	18	70	1	27	30	74					
43 x 68	16.6	1	10	10	1	13	13	1	20	22	106 x 68	40.1	2	15	15	2	18	18	70	1	27	30	74					
48 x 76	20.5	1	10	10	1	13	13	1	20	22																		
53 x 83	24.8	1	10	10	1	13	13	1	20	22																		
58 x 91	29.5	1	10	10	1	13	13	1	20	22																		
63 x 98	34.6	1	10	10	1	13	13	1	20	22																		
68 x106	40.1	1	10	10	1	13	13	1	20	22																		

NOTE: NL indicates no limit.

ROUND PIPE																			
Size	Area of Open'g	CLASS I			CLASS II			CLASS III				CLASS IV				CLASS V			
		Crack D Load 800			Crack D Load 1000			Crack D Load 1350				Crack D Load 2000				Crack D Load 3000			
		Min.	Type		Min.	Type		Min.	Type			Min.	Type			Min.	Type		
			(1)	(2)		(1)	(2)		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
12	0.8	3	8	9	3	11	14	3	40	NL	NL	2	NL	NL	NL	1	NL	NL	NL
15	1.2	3	8	9	3	11	14	3	30	NL	NL	2	60	NL	NL	1	NL	NL	NL
18	1.8	3	8	9	3	11	14	3	25	NL	NL	2	40	NL	NL	1	NL	NL	NL
21	2.4	3	8	9	3	11	14	2	20	30	44	1	30	NL	NL	1	NL	NL	NL
24	3.1	3	8	9	3	11	11	2	15	20	39	1	25	NL	NL	I	NL	NL	NL
30	4.9	3	8	9	3	11	11	2	15	20	35	1	23	NL	65	I	60	NL	NL
36	7.1	3	8	9	3	11	11	2	15	15	35	1	23	40	62	I	45	NL	NL
42	9.6	3	8	9	2	11	11	2	15	15	35	1	23	30	62	1	35	NL	NL
48	12.6	3	8	9	2	11	11	2	15	15	35	1	23	26	59	1	32	NL	100
54	15.9	3	8	9	2	11	11	2	15	15	35	1	23	24	59	1	32	60	95
60	19.6	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	48	90
66	23.8	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	47	85
72	28.3	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	43	85
78	33.2	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	43	85
84	38.5	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	43	85
90	44.2	3	8	9	2	11	11	2	15	15	34	1	23	23	56	1	32	43	85
96	50.3	3	8	9	2	11	11	2	15	15	33	1	23	23	54	1	32	43	80
102	56.7	3	8	9	2	11	11	2	15	15	31	1	23	23	52	1	32	43	80
108	63.6	3	8	9	2	11	11	2	15	15	30	1	23	23	50	1	32	43	80

GENERAL NOTES

All fill heights are measured in feet from finished grade to top of pipe.

Minimum fill heights shall be as noted except no pipe shall extend above subgrade.

For cases not covered hereon, special designs may be prepared.

Type refers to type of placement.

For other details see Std. C-13.02.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
FILL HEIGHTS FOR REINFORCED CONCRETE PIPE		
Drawn	J.P.O. 7-65	Drawing No.
Traced	S.L.T. 8-67	
Checked	J.P.O. <i>8-68</i>	
Approved		
Engr. Plans	<i>8-68</i>	
		C-13.03

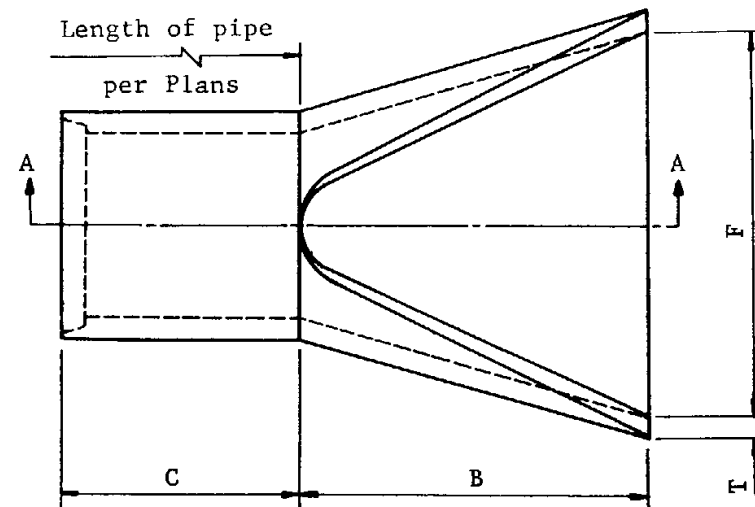
PIPE DIA.	APPROX. WEIGHT	DIMENSIONS - INCHES						APPROX. SLOPE
		T	A	B	C	E	F	
24	1520#	3	9½	43½	30	73½	48	3
27	1930#	3½	10½	49½	24	73½	54	3
30	2190#	3½	12	54	19½	73½	60	3
36	4100#	4	15	63	34½	97½	72	3
42	5380#	4½	21	63	35	98	78	3
48	6550#	5	24	72	26	98	84	3
54	8240#	5½	27	65	33½	98½	90	2½

GENERAL NOTES

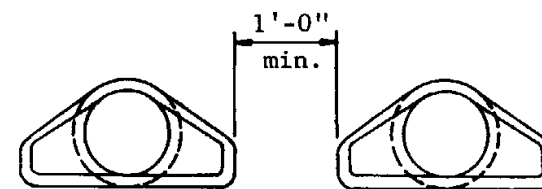
Design of end section shall conform to standards for reinforced concrete pipe.

End section joint conformation shall match the pipe joints.

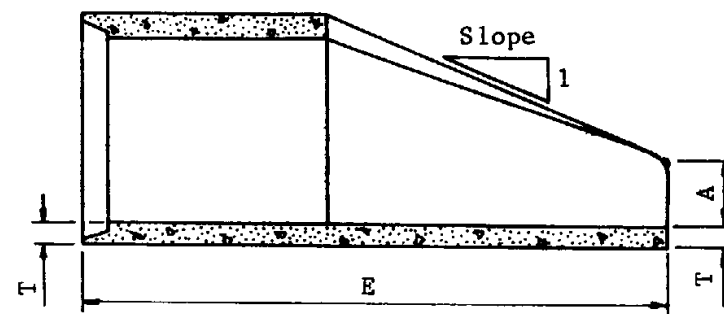
Embankment slope shall be warped to match slope of end section.



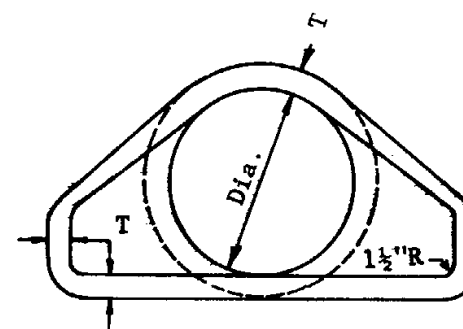
PLAN



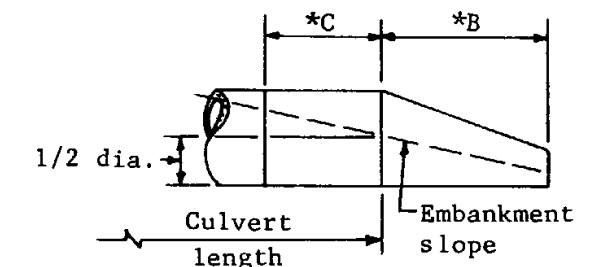
SPACING FOR MULTIPLE INSTALLATION



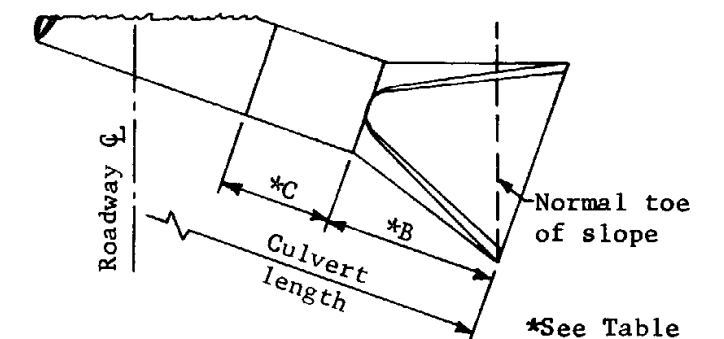
SECTION A-A



FRONT ELEVATION



Right Angle Culvert



Skewed Culvert

CULVERT LENGTH AS SHOWN ON PLANS

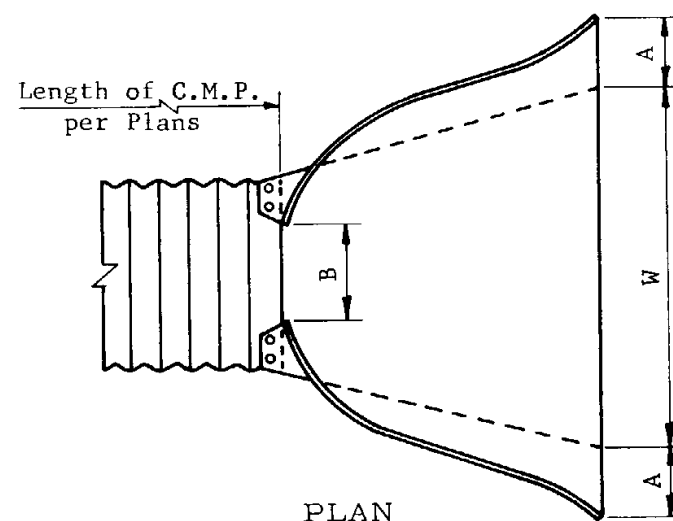
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

END SECTION REINFORCED CONCRETE PIPE

Drawn D.G. - 4-67
Traced S.L.T. - 5-67
Checked J.P.O. 8PD 5-68
Approved
Engr. Plans *[Signature]* 5-68

Drawing No.
C-13.04

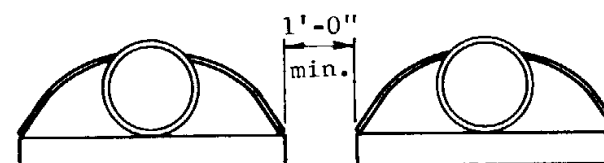
Rev



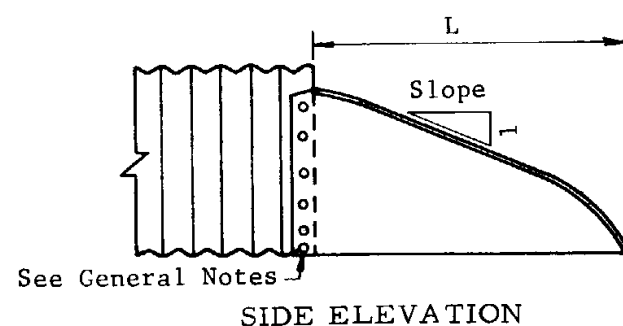
PLAN

PIPE DIA.	GA.	DIMENSIONS - INCHES					APPROX. SLOPE
		A ± 1	B Max.	H ± 1	L $\pm 1\frac{1}{2}$	W ± 2	
24	16	10	13	6	41	48	2 1/2
30	14	12	16	8	51	60	2 1/2
36	14	14	19	9	60	72	2 1/2
42	12	16	22	11	69	84	2 1/2
48	12	18	27	12	78	90	2 1/4
54	12	18	30	12	84	102	2

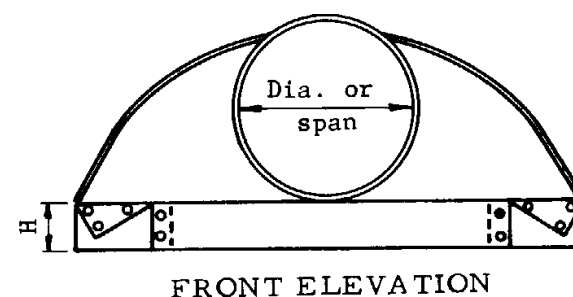
PIPE ARCH	SPAN	RISE	GA.	DIMENSIONS - INCHES					APPROX. SLOPE
				A ± 1	B Max.	H ± 1	L $\pm 1\frac{1}{2}$	W ± 2	
	29	18	16	9	14	6	32	48	2 1/2
	36	22	14	10	16	6	39	60	2 1/2
	43	27	14	12	18	8	46	75	2 1/2
	50	31	12	13	21	9	53	85	2 1/2
	58	36	12	18	26	12	63	90	2 1/2
	65	40	12	18	30	12	70	102	2 1/2
	72	44	12	18	33	12	77	114	2 1/4



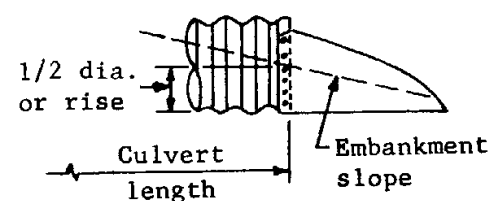
SPACING FOR MULTIPLE INSTALLATION



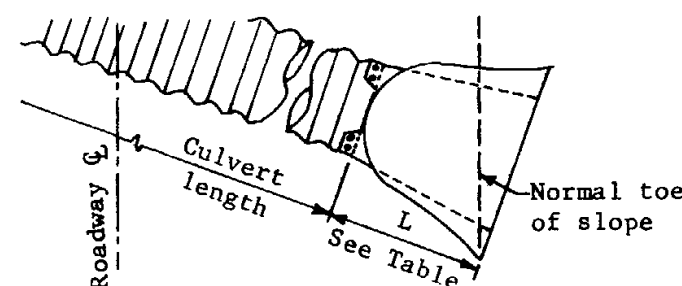
SIDE ELEVATION



FRONT ELEVATION



Right Angle Culvert



Skewed Culvert

CULVERT LENGTH AS SHOWN ON PLANS

GENERAL NOTES

The end section shall be joined to the pipe, arch or connector by welding or 3/8" bolts or rivets. The maximum allowable spacing of the bolts or rivets shall be 1'-0" but in no case shall there be less than 12 bolts or rivets per joint.

When a connector is used, the pipe or arch and the connector shall be joined by a standard coupling band.

End sections comprised of two or more pieces may be field assembled using 3/8" bolts or rivets.

End sections may be welded, bolted, or riveted directly to pipe or arch without use of 24" connectors.

All components of the end section shall be galvanized.

Embankment slope shall be warped to match slope of end section.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

END SECTION
CORRUGATED METAL
PIPE AND PIPE ARCH

Drawn	D.G. 4-67	Drawing No. C-13.05
Traced	R.A.F. 6-67	
Checked	J.P.O. 7-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

Dia.	16 Ga.-.064"		14 Ga.-.079"		12 Ga.-.109"		10 Ga.-.138"		8 Ga.-.168"	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
12	2	76	2	83						
15	2	60	2	66						
18	3	51	2	56	1	71				
24	3	37	2	41	1	48				
30	3	31	2	33	1	37				
36	3	26	2	28	1	32	1	34		
42	2	26	2	28	2	29	2	31	2	32
48	2	26	2	27	2	28	2	29	2	30
54			2	26	2	27	2	28	2	28
60					2	26	2	27	2	28
66					2	26	2	26	2	27
72							2	26	2	26
78									3	26
84									3	26

Dia.	16 Ga.-.064"		14 Ga.-.079"		12 Ga.-.109"		10 Ga.-.138"		8 Ga.-.168"	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
36	2	29	2	41	1	56	1	65	1	70
42	2	24	2	35	1	44	1	50	1	60
48	3	21	2	30	1	38	1	42	1	49
54	3	19	2	27	1	34	1	37	1	42
60	3	18	2	24	2	31	2	34	1	37
66	3	16	3	22	2	30	2	32	2	34
72	3	15	3	20	2	29	2	30	2	32
78	3	13	3	18	2	28	2	29	2	31
84			3	18	2	27	2	28	2	29
90			3	17	3	26	3	27	3	28
96					3	24	3	25	3	26
102					3	22	3	24	3	25
108					3	21	3	22	3	23
114							3	21	3	22
120							3	20	3	21

Dia.	12 Ga.		10 Ga.		8 Ga.		7 Ga.		5 Ga.		3 Ga.		1 Ga.						
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.				
		(1)		(1)		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)			
60	1	39	1	57	1	66	75	1	71	86	1	79	158	1	88	176	1	96	198
72	1	32	1	46	1	49	63	1	52	72	1	56	87	1	61	122	1	66	132
84	1	28	1	38	1	40	54	1	42	62	1	45	74	1	48	88	1	51	102
96	2	24	2	34	2	35	47	2	36	54	2	38	65	2	40	77	2	42	83
108	2	21	2	31	2	32	42	2	33	48	2	34	58	2	36	67	2	37	73
120	2	19	2	29	2	30	37	2	31	42	2	32	52	2	33	60	2	34	66
132	3	18	3	26	3	29	33	3	29	39	3	30	46	3	31	55	3	32	60
144	3	16	3	23	3	28	31	3	28	36	3	29	42	3	29	51	3	30	55
156	3	15	3	21	3	27	29	3	27	33	3	28	40	3	28	47	3	29	51
168	3	14	3	19	3	26		3	27	30	3	27	37	3	28	43	3	28	47
180	3	13	3	18	3	24		3	27	29	3	27	34	3	27	41	3	27	44
192			3	18	3	23		3	26		3	27	32	3	27	38	3	27	42
204			4	17	4	22		4	25		4	26	30	4	26	36	4	27	40
216					4	20		4	24		4	26	29	4	26	34	4	26	37
228					4	20		4	22		4	26		4	26	32	4	26	35
240								4	21		4	26		4	26	30	4	26	33
252											4	25		4	26	30	4	26	31

NOTE: (1) indicates circular pipe.
(2) indicates 5% vertically elongated pipe.
When sizes below heavy line are used, design calculations shall be prepared and submitted for checking.

* Bolts shall be torqued to not less than 200 ft. lbs. nor greater than 300 ft. lbs.

GENERAL NOTES
All fill heights are measured, in feet, from finished grade to top of pipe.
Minimum fill heights shall be as noted except no pipe shall extend above the subgrade.
Fill heights over 100' shall be used only after a thorough investigation of the foundation material.
All corrugated metal pipe and appurtenant parts shall be galvanized.
For installation details, see Std. C-13.01.
For fill height design data, see Std. C-13.07.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
CORRUGATED METAL PIPE DESIGN FILL HEIGHTS		
Drawn	D.G.	Drawing No.
Traced	S.L.T. 9-67	
Checked	J.P.O. 8/10 5-68	
Approved Engr. Plans	H. Heidecker 5-68	C-13.06

2 2/3" X 1/2" Corrugations						3" X 1" Corrugations						6" X 2" Corrugations					
Gage	A _s	I	r	C _u		A _s	I	r	C _u			A _s	I	r	C _u		
				1 rivet	2 rivet				2-5/16 rivets	2-3/8 rivets	2-7/16 rivets				4-bolts ft.	6-bolts ft.	8-bolts ft.
16	.0646	.001892	.1726	16750	21500	.0742	.008658	.3452	19200	25800							
14	.0808	.002392	.1726	18200	29800	.0927	.010833	.3452	26500	34300							
12	.1130	.003425	.1726	23400	46800	.130	.015458	.3452		41600	53000	.1297	.060416	.688	42000		
10	.1454	.004533	.1726	24500	49000	.1674	.020175	.3452		43500	61000	.1669	.078166	.688	62000		
8	.17775	.005725	.1726	25600	51300	.2048	.025083	.3452		45600	64000	.2041	.096166	.688	81000		
7												.2283	.1078	.688	93000		
5												.2666	.126916	.688	112000		
3												.3048	.146166	.688	132000		
1												.3432	.165833	.688	144000	184000	220000
3/8"												.4680	.232	.688			270000

7/8" bolts. All other 6" X 2" C_u values are for 3/4" bolts.

Criterion 1. DEFLECTION OF PIPE

$$\text{Formula 1(a) } I(\text{for circular pipe}) = \frac{2.31 R^3 h - 57.3 R^3}{26,800,000}$$

Formula 1(b) I(for 5% vertically elongated pipe)=Substitute h/2 for h in 1a. Solve 1a for I and determine required gauge and corrugation from table. If 6" X 2" corrugation is indicated, solve for I in 1(b) to determine gauge required for elongated pipe. If I is negative, metal thickness required is less than the minimum tabular value.

Criterion 2. LONGITUDINAL SEAM STRENGTH

$$\text{Formula 2(a) } C_a = \frac{Dh}{0.0046}$$

Solve for C_a and determine gauge and corrugation from table of C_u values.

Criterion 3. BUCKLING OF PIPE WALL

$$\text{Formula 3(a) } f_u = 45,000 - 1.4547 \left[\frac{0.64 R}{r} \right]^2$$

Use r for the corrugation corresponding to the heaviest gauge determined by formulae 1a, 1b and 2a. Solve for f_u to determine the maximum allowable buckling stress.

$$\text{Formula 3(b) } A_s = \frac{1.805 R h}{f_u}$$

Solve for A_s, using f_u value determined in 3a, and select gauge and corrugation from table.

* When Deflection or Buckling is the control, an increase in the maximum h may be realized by backfilling to 95% Proctor density. This revises the applicable formulae to:

$$\text{Formula 1(a) } I = \frac{2.08 R^3 h - 57.3 R^3}{26,800,000}$$

$$\text{Formula 3(a) } f_u = 45,000 - 1.4547 \left[\frac{0.44 R}{r} \right]^2$$

EXAMPLE

Given: h = 27; D = 15; R = 90
Find: Gauge and corrugation required.

Solution:
Deflection of pipe

$$\text{Formula 1(a) } I = \frac{(2.31)(729,000)(27) - (57.3)(729,000)}{26,800,000} = 0.138$$

I values in table indicate a gauge requirement, for circular pipe, of 5 in 6" X 2" corr.

$$\text{Formula 1(b) } I = \frac{(1.155)(729,000)(27) - (57.3)(729,000)}{26,800,000} = -0.711$$

The result being negative indicates a gauge requirement lighter than 12 gauge when pipe is elongated 5% vertically.

Longitudinal Seam Strength

$$\text{Formula 2(a) } C_a = \frac{(15)(27)}{0.0046} = 88,000$$

Referring to table, 7 gauge, 6" X 2" corr. is required.

Buckling of Pipe Wall

$$\text{Formula 3(a) } f_u = 45,000 - 1.4547 \left[\frac{(0.64)(90)}{.688} \right]^2 = 34820$$

Note that since a 6" X 2" corr. is indicated by the preceding results, the 6" X 2" value for r is used.

The result (allowable buckling stress) is used in the following formula 3(b) to determine gauge requirement.

$$\text{Formula 3(b) } A_s = \frac{(1.805)(90)(27)}{34820} = 0.126$$

The table indicates a gauge requirement of 12 gauge in 6" X 2" corr.

Analysis:

Using vertically elongated pipe, the lightest gauge and corr. that will satisfy all requirements is 7 gauge, 6" X 2" corr. Similarly, with circular pipe the lightest gauge is 5. Since cost-wise the two are comparable, 7 ga., 6" X 2" 5% vertically elongated pipe is selected.

Criteria 1, 2 and 3 embody the factors to be investigated in the design of corrugated metal pipe culverts.

Appurtenant formulae are developed from data supplied by the B.P.R. 1966 publication titled "Corrugated Metal Pipe Culverts - Structural Design Criteria and Recommended Installation Practices." These formulae provide safety factors as follows: Criteria 1 = 3.33; Criteria 2 = 3.33 and Criteria 3 = 2.00.

Constants used are:

Embankment weight/cu. ft. = 130 lbs.

Embankment density = 90% Proctor.

Modulus of passive earth resistance = 1000 p.s.i.

Soil stiffness coefficient = 0.32.

Deflection lag factor = 1.39.

Modulus of elasticity = 29,000,000 p.s.i.

Explanation of symbols used:

A_s = Area/lin. inch of pipe in sq. inches.

C_a = Actual ring compression in lb./ft.

C_u = Allowable ring compression in lb./ft.

D = Pipe diameter in ft.

f_a = Actual buckling stress in p.s.i.

f_u = Allowable buckling stress in p.s.i.

h = Fill height; fin. grade to top of pipe in ft.

I = Moment of inertia of pipe wall in inches⁴/inch.

R = Radius of pipe in inches.

r = Radius of gyration of pipe wall in inches.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
CORRUGATED METAL PIPE FILL HEIGHT DESIGN DATA		
Drawn	D.G. 9-67	Drawing No.
Traced	S.L.T. 10-67	
Checked	J.P.O. 8PO 5-68	
Approved		
Engr. Plans	8/11/68 5-68	C-13.07

TABLE 1-A												
CORRUGATED, STEEL PIPE ARCH. 2 2/3" X 1/2" CORRUGATIONS. RIVETED, WELDED OR LOCK SEAM FABRICATION. H-20 LOADING												
Size - In. Span X Rise	Opening Area Sq. Ft.	Corner Radius In.	Fill Heights - Ft.									
			Maximum Corner Pressure = 4000 Lb./Sq. Ft.									
			16 Ga.-.064"		14 Ga.-.079"		12 Ga.-.109"		10 Ga.-.138"		8 Ga.-.168"	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18 X 11	1.1	3.5	1 1/2	12	1 1/2	12	1 1/2	12	1 1/2	12	1 1/2	12
22 X 13	1.6	4.0	1 1/2	11	1 1/2	11	1 1/2	11	1 1/2	11	1 1/2	11
25 X 16	2.2	4.0	2	10	2	10	2	10	2	10	2	10
29 X 18	2.8	4.5	2	10	2	10	2	10	2	10	2	10
36 X 22	4.4	5.0	2	9	2	9	2	9	2	9	2	9
43 X 27	6.4	5.5	2	8	2	8	2	8	2	8	2	8
50 X 31	8.7	6.0	3	7	3	7	3	7	3	7	3	7
58 X 36	11.4	7.0			3	7	3	7	3	7	3	7
65 X 40	14.3	8.0					3	8	3	8	3	8
72 X 44	17.6	9.0							4	8	4	8

GENERAL NOTES

All fill heights are measured from finished grade to top of pipe arch.
Minimum fill heights shall be as noted except no pipe arch shall extend above the subgrade.
To determine fill heights for sizes other than those shown in the tables, use Std. C-13.09 Pipe Arch Design Data.

TABLE 2-A										
STRUCTURAL PLATE PIPE ARCH. 6" X 2" Corrugations. BOLTED FABRICATION, 4-BOLTS/FT. * H-20 LOADING										
Size Span & Rise	Opening Area Sq. Ft.	Corner Radius In.	Fill Heights - Ft.							
			Max. Corner Pressure= 4000 Lb./Sq. Ft.							
			12 Ga.		10 Ga.		8 Ga.		7 Ga.	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
6' - 1" X 4' - 7"	22	18	1	15	1	15	1	15	1	15
7' - 0" X 5' - 1"	28	18	1 1/2	13	1 1/2	13	1 1/2	13	1 1/2	13
7' - 11" X 5' - 7"	35	18	1 1/2	12	1 1/2	12	1 1/2	12	1 1/2	12
8' - 10" X 6' - 1"	43	18	1 1/2	10	1 1/2	10	1 1/2	10	1 1/2	10
9' - 9" X 6' - 7"	52	18	2	9	2	9	2	9	2	9
10' - 11" X 7' - 1"	61	18	2	8	2	8	2	8	2	8
11' - 10" X 7' - 7"	71	18			2	7	2	7	2	7
12' - 8" X 8' - 1"	81	18			3	6	3	6	3	6

* Bolts shall be torqued to not less than 200 ft. lbs. nor greater than 300 ft. lbs.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev	
CORRUGATED METAL PIPE ARCH DESIGN FILL HEIGHTS			
Drawn	D.G. 10-67		Drawing No. C-13.08
Traced	S.L.T. 10-67		
Checked	J.P.O. 8PO 5-68		
Approved Engr. Plans	<i>W. Schneider</i> 5-68		

TABLE I					
2 2/3" X 1/2" Corrugations			6" X 2" Corrugations		
Gage	A _s	I	r	C _u	
				1 rivet	2 rivet
16	.0646	.001892	.1726	16750	21500
14	.0808	.002392	.1726	18200	29800
12	.1130	.003425	.1726	23400	46800
10	.1454	.004533	.1726	24500	49000
8	.17775	.005725	.1726	25600	51300
7					
5					
3					
1					

TABLE II			
h or h'	L _L	L _D	L _L +L _D
1'	1800	130	1930
2'	800	260	1060
3'	600	390	990
4'	400	520	920
5'	250	650	900
6'	200	780	980
7'	175	910	1085
8'	100	1040	1140

For h=9' and over, L_L is eliminated so total load then becomes h X 130.

Criterion I CORNER PRESSURE

Formula 1 (a) $P = \frac{6S(L_L + L_D)}{R_c}$

Using h, take (L_L + L_D) from Table II and solve for P.
Note: If P>4000, consideration shall be given toward possible special back fill design.

Formula 1 (b) $(L_L + L_D) = \frac{667R_c}{S}$

Solve for L_L + L_D. Use Table II to determine h'.

Criterion 2 LONGITUDINAL SEAM STRENGTH.

Formula 2 $C_a = 1.67S (L_L + L_D)$
Using h, take (L_L + L_D) from Table II and solve for C_a.
Determine gauge and corr. by comparing C_a with C_u values in Table I.

Criterion 3 BUCKLING OF PIPE ARCH WALL

Formula 3 (a) $f_u = 22500 - 0.72735 (3.84S/r)^2$

Formula 3 (b) $f_u = \frac{S(L_L + L_D)}{24A_s}$

Use r for corrugation indicated by Formula 2
Equate f_u from 3(a) in 3(b) and solve for A_s
Determine gauge and corrugation from Table I.

Criterion 4 DEFLECTION

Formula 4(a) $\Delta_u = 0.6H$

Formula 4(b) $\Delta_a = \frac{1.507hSR^3}{29,000,000 I + 61R^3}$

Use value I of heaviest gauge and corrugation required by Criteria 2 and 3. If $\Delta_u > \Delta_a$, deflection is satisfactory.

EXAMPLE:

Given: 72" X 44" Pipe Arch, h = 15, R_c = 9.

Find: Gauge, corrugation, h'

Formula 1(a) $P = \frac{6 \times 6 \times 1950}{9}$

= 7800

Since P>4000 investigation of special backfill and/or corner support design is mandatory.

Formula 1(b) $(L_L + L_D) = \frac{667 \times 9}{6}$
= 1000

From Table II, h' = 3

Formula 2 $C_a = 1.67 \times 6 \times 1950$
= 19550

Referring to Table I, 12 ga., 1-rivet, 2 2/3" X 1/2" is satisfactory with respect to seam strength

Formula 3(a) $f_u = 22500 - 0.72735 \times (3.84 \times 6 / .1726)^2$
= 9620

Formula 3(b) $9620 = \frac{6 \times 1950}{24A_s}$

A_s = 0.0507

Referring to Table I, value of A_s indicates a lighter gauge than that called for in Formula 2 so 12 ga., 1-rivet, 2 2/3" X 1/2" is safe from buckling.

Formula 4 (a) $\Delta_u = 0.6 \times 3.67$
= 2.202

$\Delta_a = \frac{1.507 \times 15 \times 6 \times (3 \times 6 + 3 \times 3.67)^3}{29,000,000 \times 0.003425 + 61 \times (3 \times 6 + 3 \times 3.67)^3}$
= 2.08

$\Delta_u > \Delta_a$ so deflection is satisfactory.

Criteria 1, 2, 3 and 4 embody the factors to be investigated in the design of corrugated metal pipe arch culverts.

Appurtenant formulae are condensed from data supplied by the 1967 edition of American Iron and Steel Institute's publication titled "Handbook of Steel Drainage and Highway Construction Products" and the B. P. R. 1966 publication titled "Corrugated Metal Pipe Culverts - Structural Design Criteria and Recommended Installation Practices." These formulae provide safety factors of 1, 3.33, 2 and 3.33 respectively for Criteria 1, 2, 3 and 4.

Constants used are the same as for Std. C-13.07, "Corrugated Metal Pipe Fill Height Design Data."

Explanation of variable symbols used:

A_s = Area per lin. inch of pipe arch in sq. in.

C_a = Actual ring compression in lbs./ft.

C_u = Allowable ring compression in lbs./ft.

f_u = Allowable buckling stress in p.s.i.

h = Max. fill height; fin. grade to top of pipe arch.

h' = Min. fill height; fin. grade to top of pipe arch.

I = Moment of inertia of pipe arch wall in inches⁴/inch

R = 3H+3S in inches

r = Radius of gyration of pipe wall in inches.

Δ_u = Allowable deflection in inches.

Δ_a = Actual deflection in inches

S = Span in ft.

H = Rise in ft.

R_c = Corner radius in inches

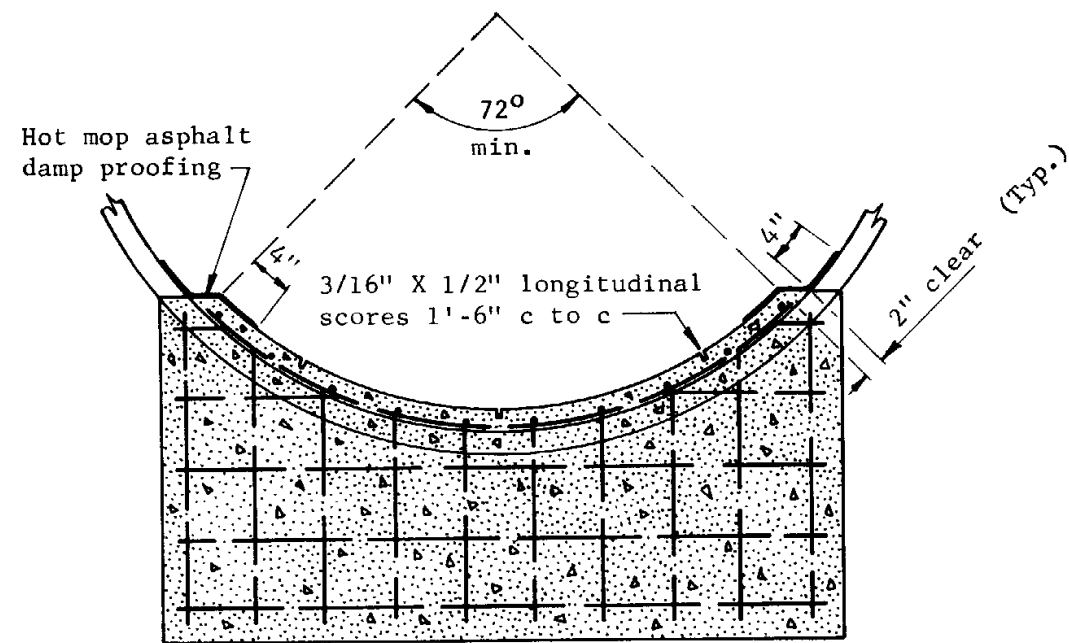
P = Corner pressure in lbs./sq.ft.

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PLANS DIVISION

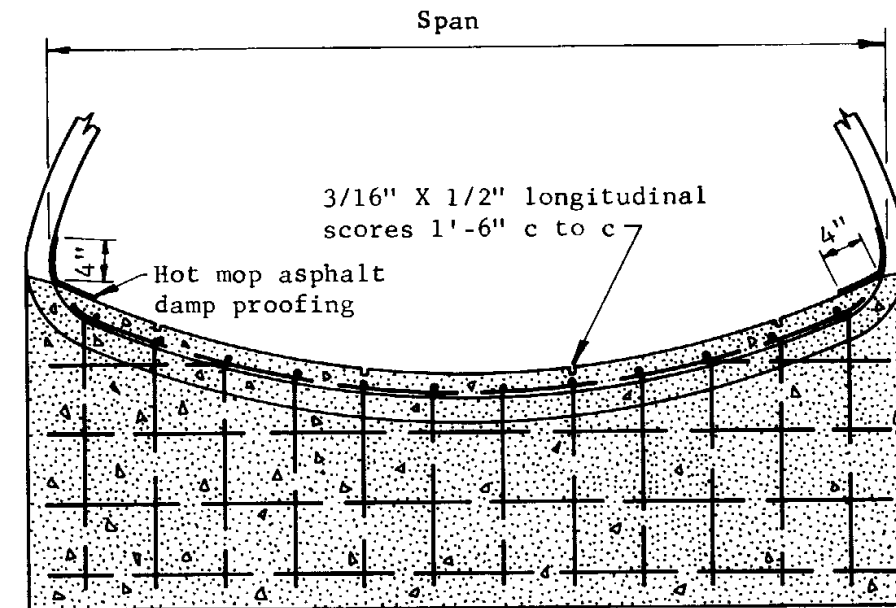
Rev

CORR. METAL PIPE ARCH
FILL HEIGHT
DESIGN DATA

Drawn	D.G. 10-67	Drawing No. C-13.09
Traced	R.A.F. 11-67	
Checked	J.P.O. 8/10 5-68	
Approved Engr. Plans	2/11/68 5-68	

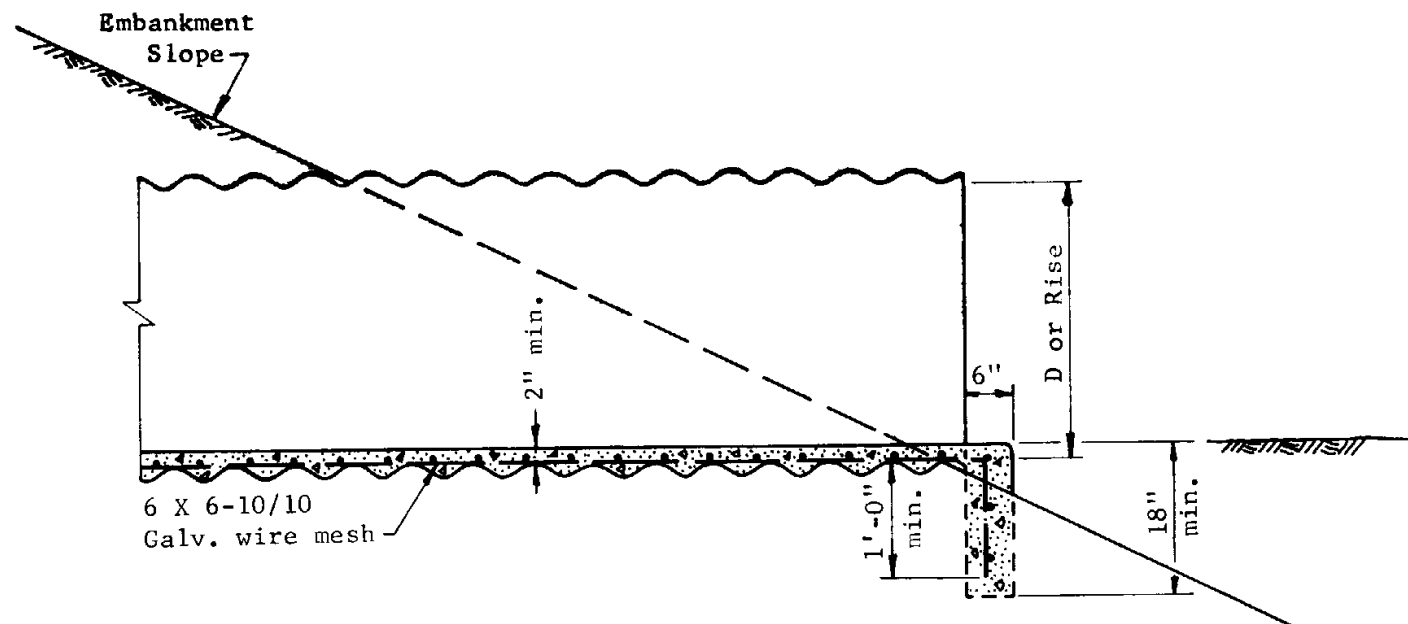


FULL CIRCULAR PIPE,
C. M. P. OR STRUCTURAL PLATE PIPE



PIPE ARCH OR
STRUCTURAL PLATE ARCH

END ELEVATIONS

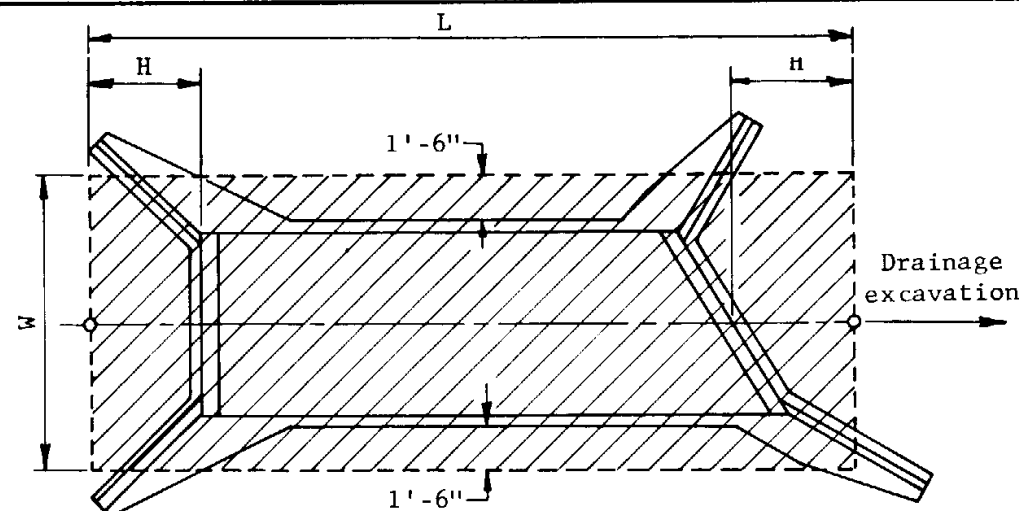


PIPE & PIPE ARCH
LONGITUDINAL SECTION

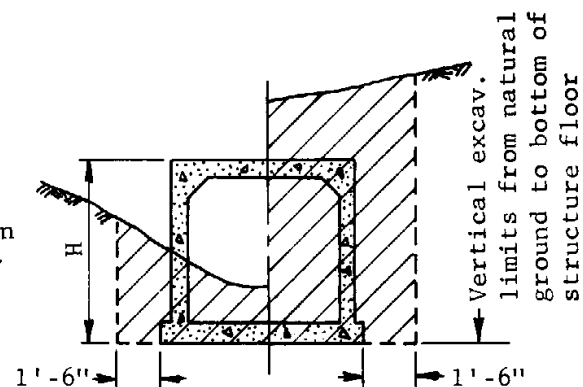
GENERAL NOTES

- The wire mesh shall be fastened or welded in an approved manner to the corrugation crests.
- All laps shall be 6" minimum.
- Invert paving shall not be placed until fill over pipe is completed.
- All concrete shall be Class A.

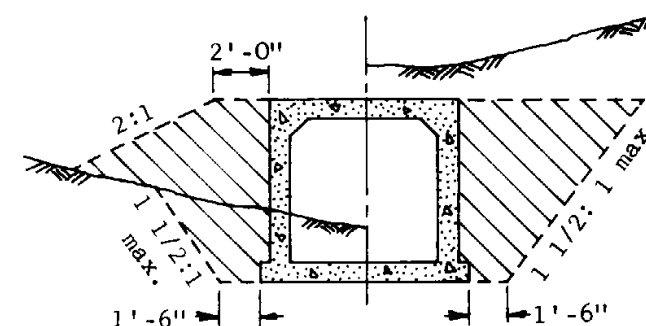
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CORRUGATED METAL PIPE CONCRETE INVERT PAVEMENT			
Drawn	D.G.	Drawing No. C-13.10	
Traced	R.A.F. 5-17-67		
Checked	J.P.O. 8PD 5-68		
Approved Engr. Plans	8/11/68 5-68		



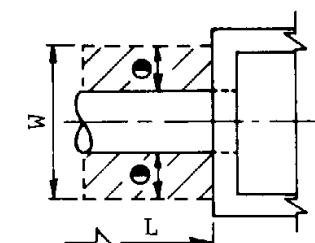
Plan View Showing Structural Excavation Length, L, and Width, W, for Payment Limits



Section Showing Structural Excavation Payment Limits



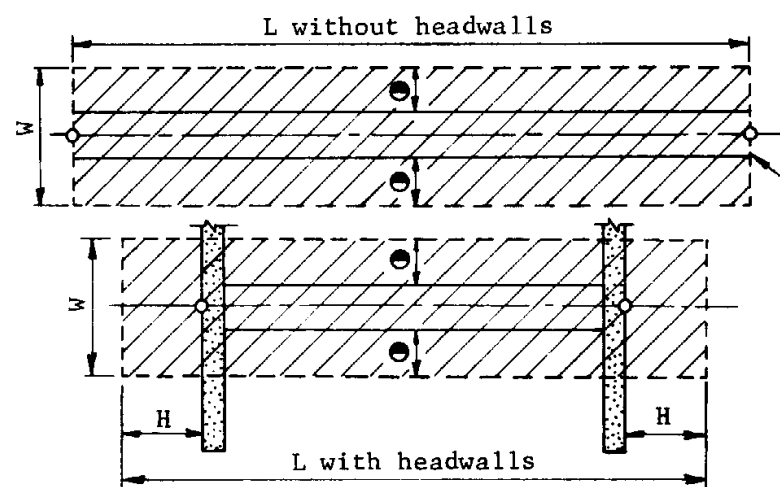
Section Showing Special Backfill



Plan Showing Catch Basin, Manhole or Similar Structure

CONCRETE BOX CULVERTS

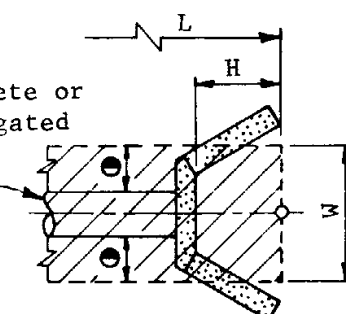
H = Height of barrel or headwall excluding cutoff wall.
 ● = 1'-6" max.



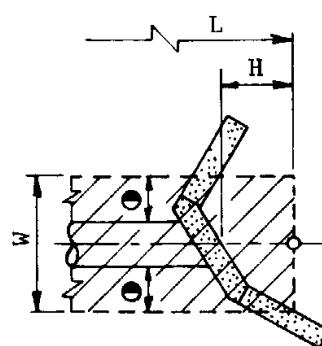
Pipe line in trench and pipe culvert with or without one or more headwalls.

Plan View Showing Length, L, and Width, W, for Payment Limits

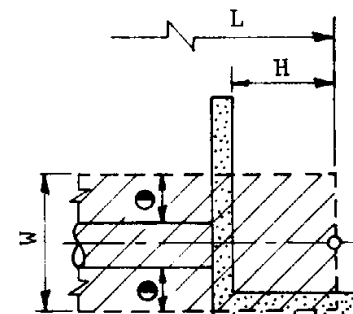
Concrete or corrugated metal pipe



Pipe with normal wingwall, flared end sect. or U headwall



Pipe with skewed wingwall



Pipe with L headwall

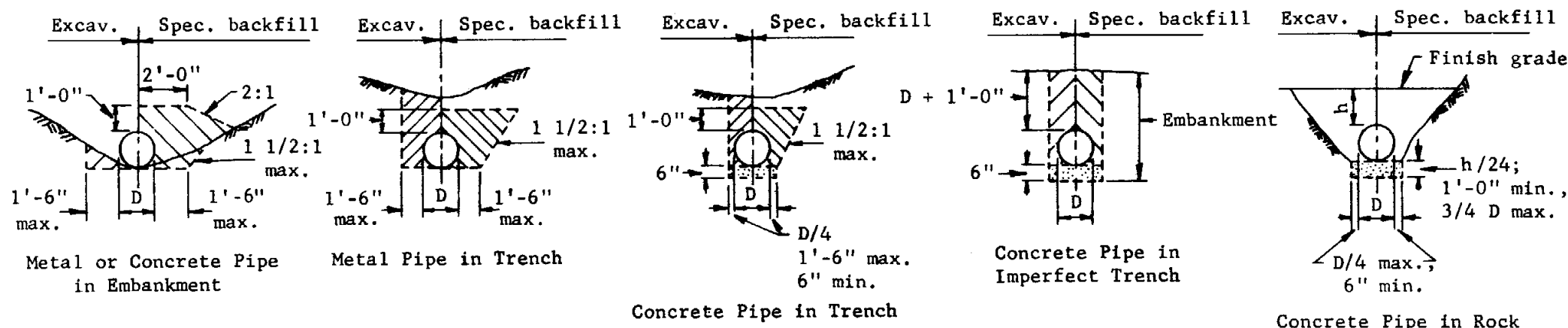
GENERAL NOTES

Payment limits shown include structural excavation for headwalls, cutoff walls, wingwalls, end sections etc.

Placement of special backfill around headwalls and wingwalls shall be the same as that for structures.

Payment limits shown shall be applied to multiple installations by discounting the overlap in width limits.

D indicates the O.D. and maximum outside width of circular and arch type structures respectively.



Sections Showing Structural Excavation Width Limits and Special Backfill Placement

PIPE LINES AND PIPE CULVERTS

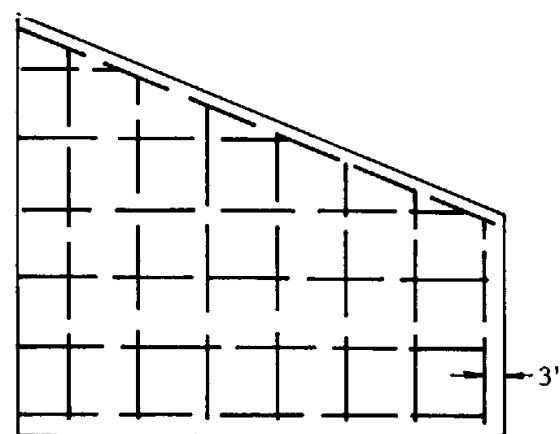
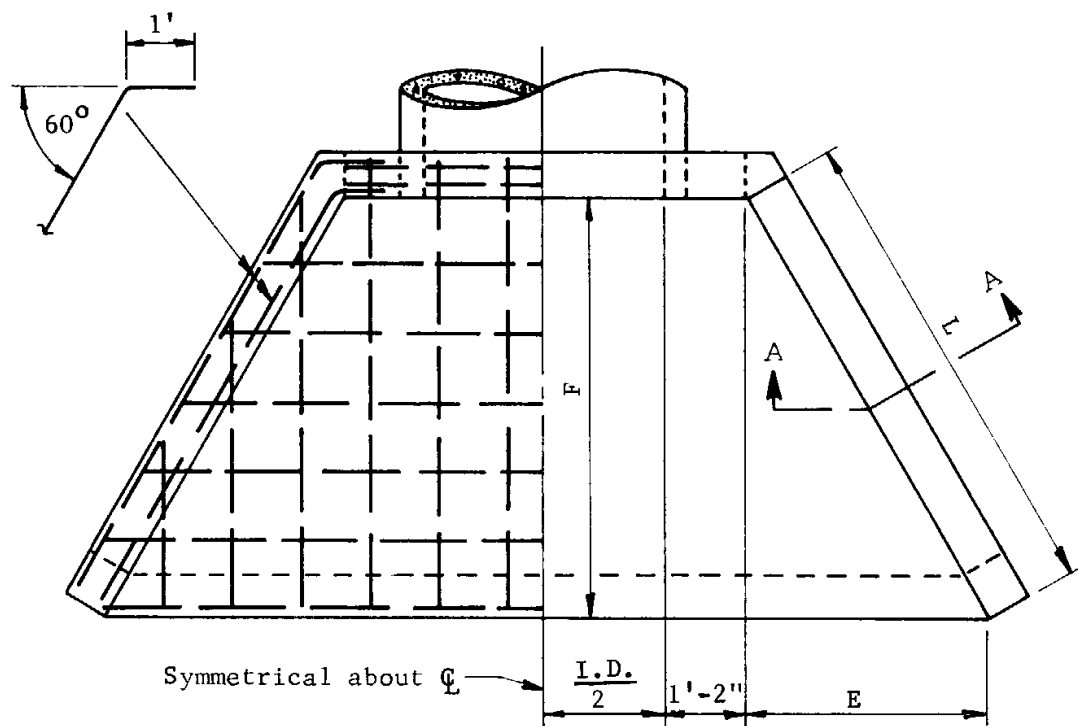
ARIZONA HIGHWAY DEPARTMENT
 PLANS DIVISION

STRUCTURAL EXCAVATION PAYMENT LIMITS AND SPECIAL BACKFILL PLACEMENT

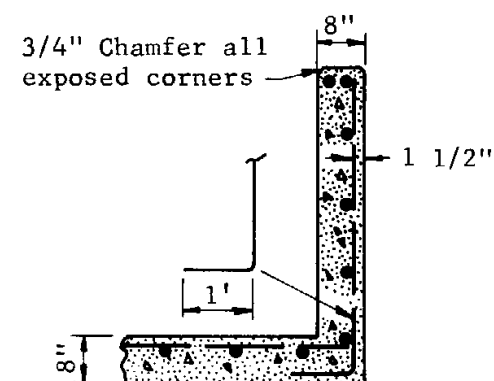
Drawn D.G. 12-66
 Traced R.A.F. 2-68
 Checked J.P.O. 9PO 5-68
 Approved Engr. Plans 9PO 5-68

Drawing No.
C-13.11

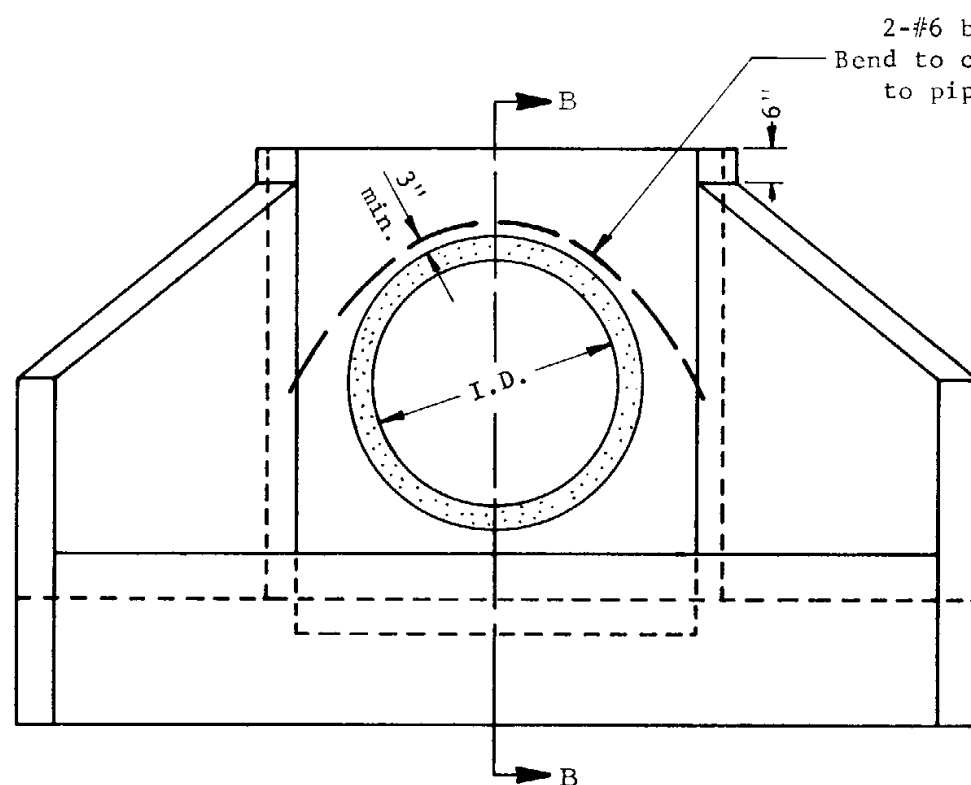
Rev



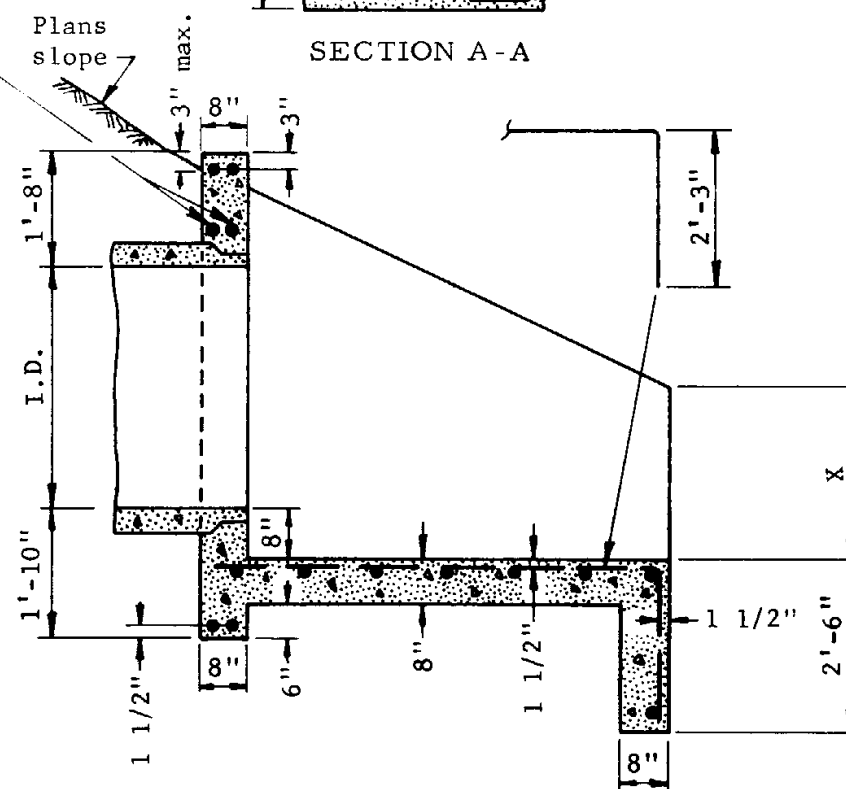
WING WALL REINFORCING



SECTION A-A



ELEVATION



SECTION B-B

PIPE	DIMENSIONS				QUANTITIES		
	I.D.	L	E	F	X	C.Y. CONC.	
						C.M.P.	Deduct for R.C.P.
42"	7'-0"	3'-6"	6'-1"	2'-6"	4.38	0.09	205
48"	7'-6"	3'-9"	6'-6"	3'-0"	5.15	0.12	265
54"	8'-0"	4'-0"	6'-11"	3'-0"	5.21	0.14	295
60"	9'-0"	4'-6"	7'-10"	3'-0"	7.09	0.18	340
66"	10'-0"	5'-0"	8'-8"	3'-3"	7.54	0.21	390
72"	11'-0"	5'-6"	9'-6"	3'-3"	8.59	0.25	480
78"	11'-6"	5'-9"	10'-0"	3'-6"	9.47	0.30	490
84"	12'-0"	6'-0"	10'-5"	3'-9"	10.35	0.34	560

GENERAL NOTES

All concrete shall be Class A.

All reinforcing bars shall be #4 except two #6 bars over pipe. Bar spacing shall be 1'-0" centers.

Plan shown is drawn for a 42" pipe.

High point of headwall shall not project more than 3" above slope.

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PLANS DIVISION

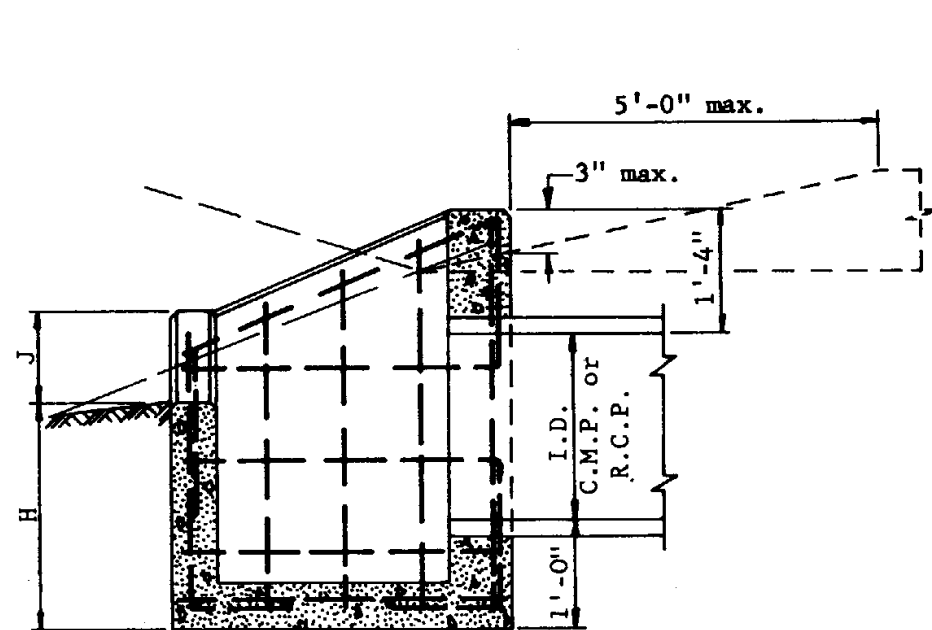
PIPE HEADWALLS
42" TO 84"
DIAMETER PIPES

Drawn W.M.D. 2-36
Traced R.A.F. 5-11-67
Checked J.P.O. 9/10 5-68
Approved Engr. Plans 5/11/68

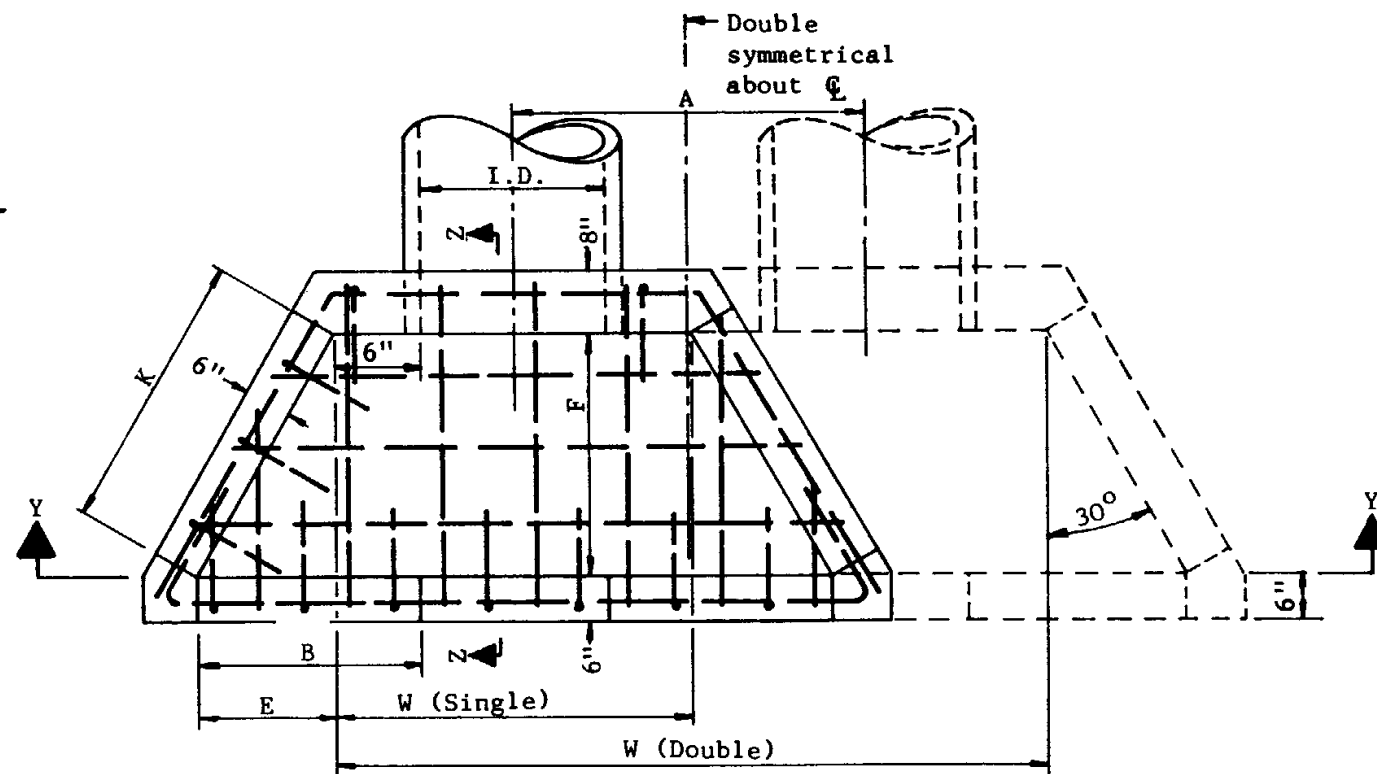
Drawing No.

C-14.02

Rev.

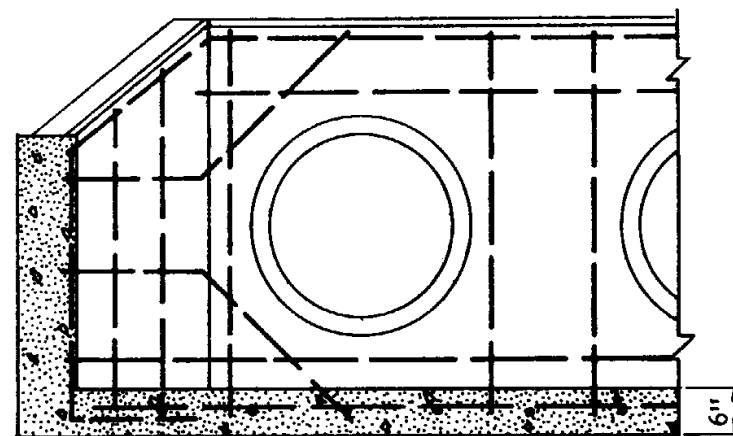


SECTION Z-Z

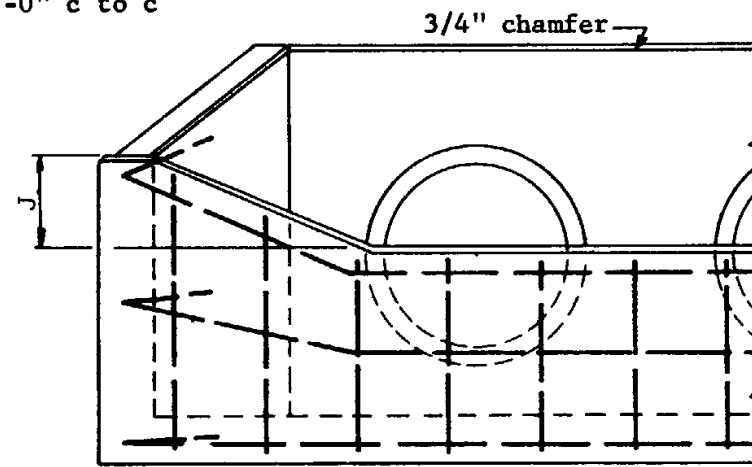


PLAN

All reinforcing shall be #4 bars 1'-0" c to c



SECTION Y-Y



ELEVATION

GENERAL NOTES
Reference Std. C-13.01.
High point of headwall shall not project more than 3" above slope.
All concrete shall be Class A.

PIPE	DIMENSIONS									QUANTITIES					
	W		A	B	E	F	H	J	K	CONC. C.Y.				REINF. STEEL	
	Single	Double								Single	Double	Single	Double	Single	Double
I.D.										C.M.P.	For Conc. Pipe Deduct	C.M.P.	For Conc. Pipe Deduct		
18"	2'-6"	5'-2"	2'-8"	1'-3"	9"	1'-3 5/8"	3'-1"	9"	1'-6"	-0.76	0.03	1.12	0.06	75	107
24"	3'-0"	6'-6"	3'-6"	1'-7 1/2"	1'-1 1/2"	1'-11 3/8"	3'-5"	11"	2'-3"	1.00	0.04	1.55	0.09	92	136
30"	3'-6"	7'-10"	4'-4"	2'-0"	1'-6"	2'-7 1/4"	3'-9"	1'-1"	3'-0"	1.50	0.06	2.29	0.13	112	166
36"	4'-0"	9'-2"	5'-2"	2'-4 1/2"	1'-10 1/2"	3'-3"	4'-0"	1'-4"	3'-9"	1.96	0.09	3.01	0.17	145	214
42"	4'-6"	10'-6"	6'-0"	2'-9"	2'-3"	3'-10 3/4"	4'-4"	1'-6"	4'-6"	2.49	0.11	3.85	0.23	189	279

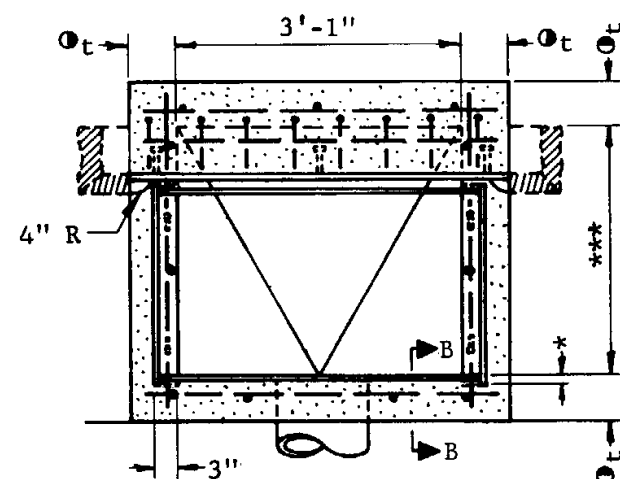
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

Rev

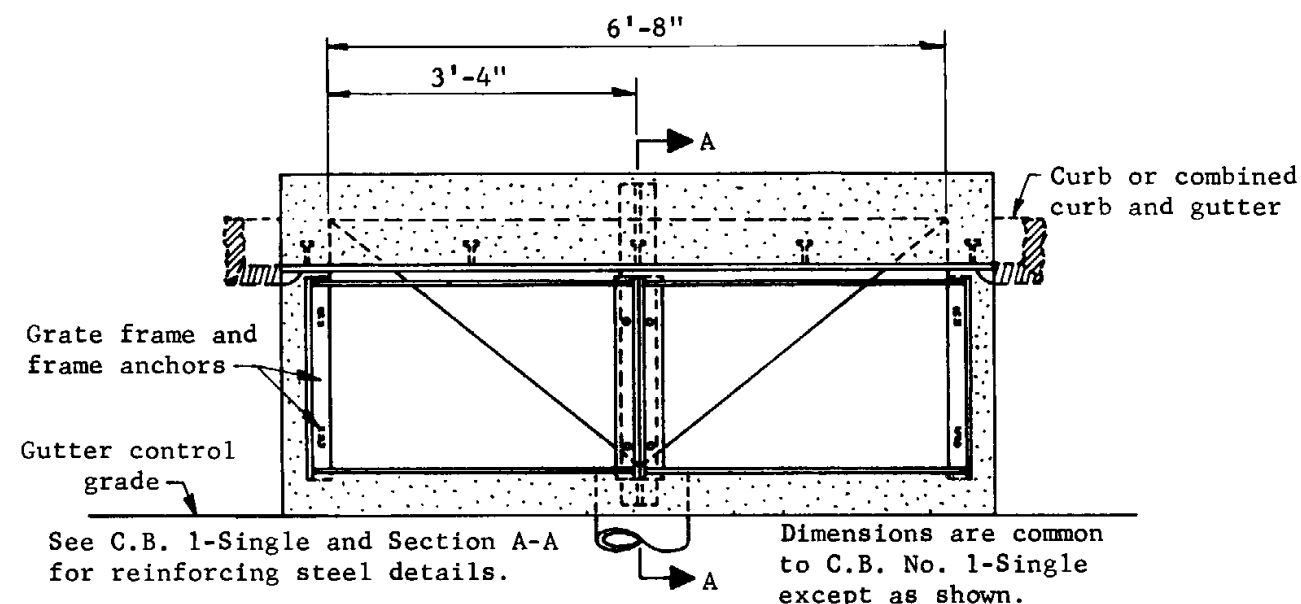
DROP INLET HEADWALLS

Drawn K.S. 10-39
Traced S.L.T. 8-67
Checked J.P.O. 890 5-68
Approved
Engr. Plans *[Signature]* 5-68

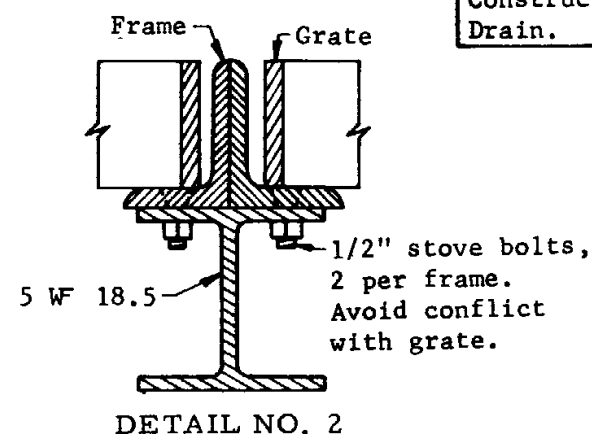
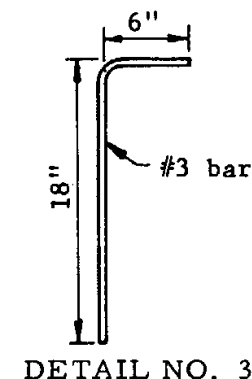
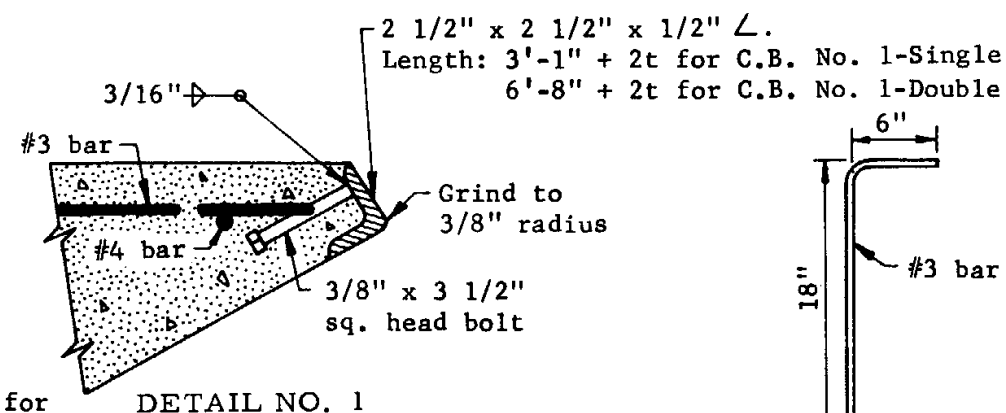
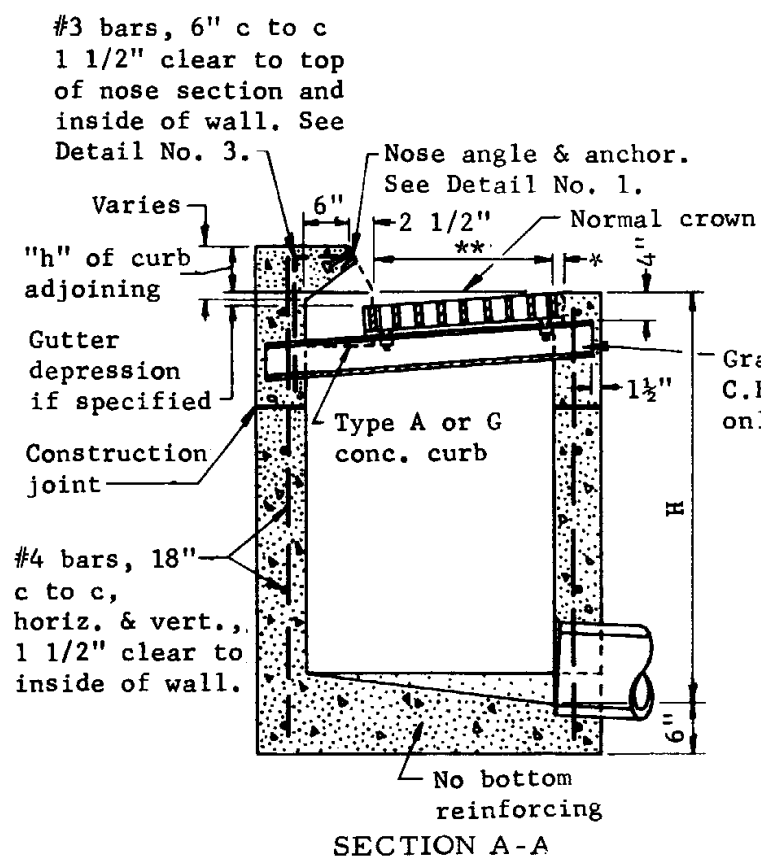
Drawing No.
C-14.03



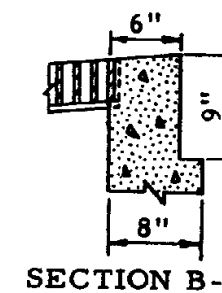
PLAN-CATCH BASIN NO. 1 - SINGLE



PLAN - CATCH BASIN NO. 1 - DOUBLE



NOTE: Provide Std. C-15.08 Construction Drain.



Use this section when t = 8"

GENERAL NOTES

Pipes can be placed in any wall.
Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.
Welding shall be in accordance with A.H.D. Welding Manual.
For grates LW-1, TW-2, etc., and frame details and opening areas, see Stds. C-15.06 and C-15.07.
Any specified gutter depression shall be warped to opening according to Std. C-15.08.
All structural steel shall be ASTM A 36.
Grate support and nose angle shall be given one shop coat of No. 1 paint.
All concrete shall be Class A.
Curb opening areas (Sq.Ft.) for Catch Basin No. 1-Single and Catch Basin No. 1-Double equal 0.26 and 0.55, respectively, for each inch of curb "h" + gutter depression - 2.1"

* 3/4" for longitudinal and 3" for transverse grates.

** 2'-0" for LW-1, LB-1, TW-1 and TB-1 grates. 1'-6" for LW-2, LB-2, TW-2 and TB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

*** 2'-8 1/2" for LW-1, LB-1, TW-1 and TB-1 grates. 2'-2 1/2" for LW-2, LB-2, TW-2 and TB-2 grates.

● t = 6" when H is 8' or less; 8" when H is over 8'. (See Section B-B)

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

TYPE 1 CATCH BASIN

Drawn	D.G. 7-67
Traced	R.A.F. 7-67
Checked	J.P.O. 8PO 5-68
Approved	
Engr. Plans	E. Heidecker 5-68

Drawing No.
C-15.01

Rev

2-1/2" X 1 1/2" button head mach. bolts with lock washers & nuts

Support angle. See Detail #1 & Table #1.

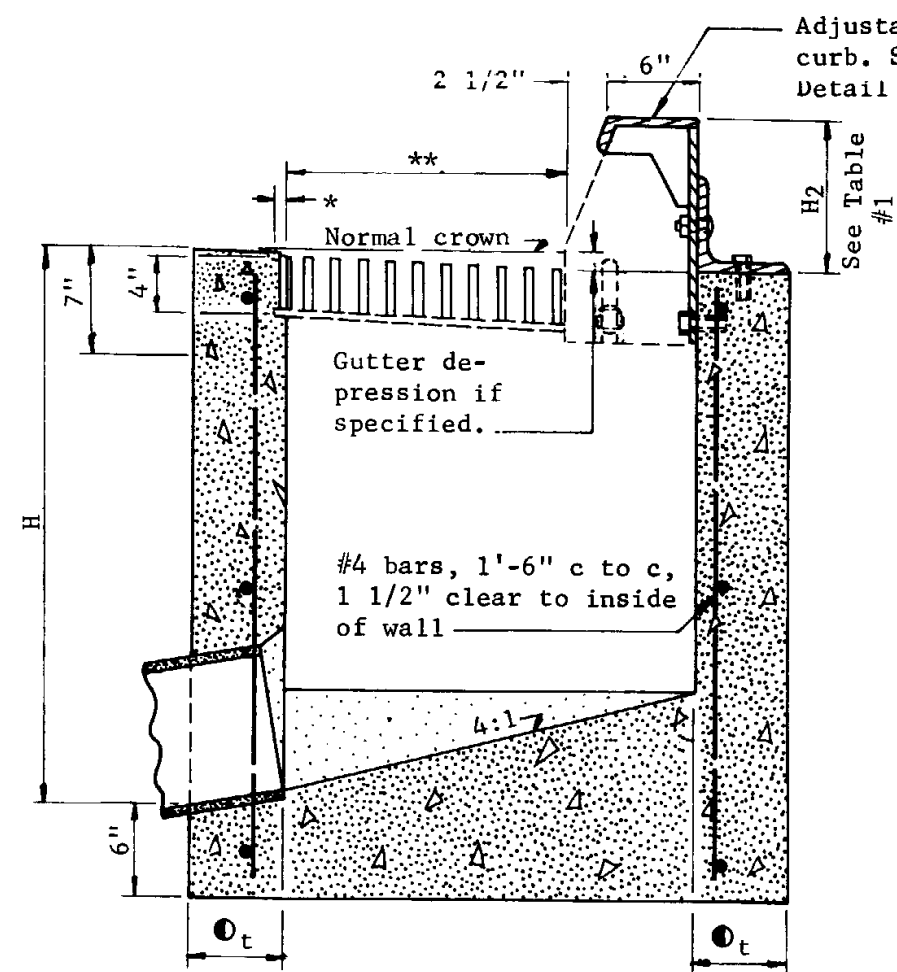
Adjustable curb. See Detail #1.

Grate and frame as specified

Gutter control grade

NOTE: Provide Std. C-15.08 Construction Drain.

PLAN



SECTION A-A

GENERAL NOTES

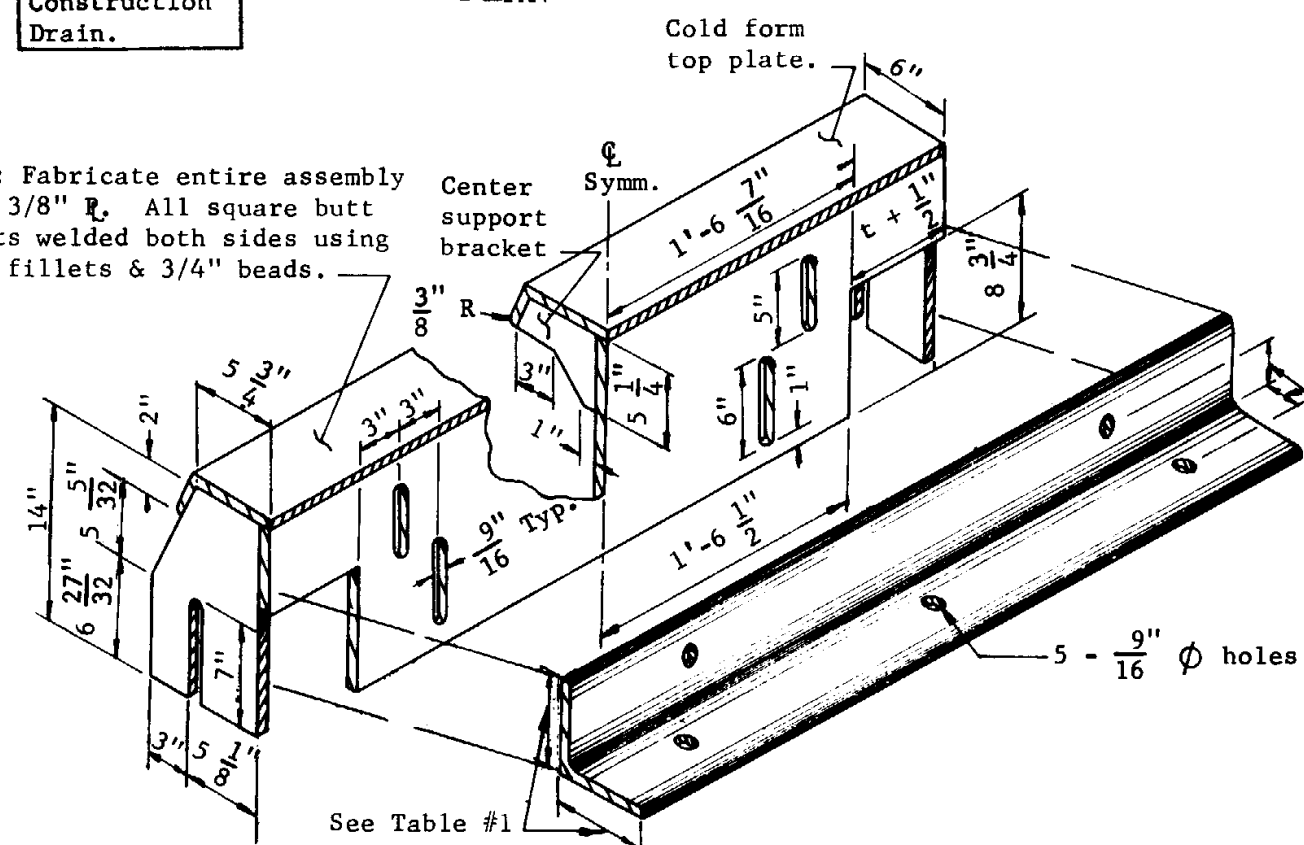
Pipes can be placed in any wall.
 1/2" chamfer top edges of sump walls.
 Basin sump floors shall have wood trowel finish and a minimum slope of 4:1 from all directions toward outlet pipe.
 Welding shall be in accordance with A.H.D. Welding Manual.
 For grates LW-1, TW-2, etc. and frame details and opening areas, see Stds. C-15.06 and C-15.07.
 Gutter depression = 3" max. modified to 1 1/2" max. for shoulder locations and no depression for adjoining medians.
 Any specified gutter and apron depression shall be warped to opening according to Standard C-15.08.
 All concrete shall be Class A.
 All Structural steel shall be ASTM A 36.
 Adjustable Curb shall be galvanized according to ASTM A 123.

* 3/4" for LW or LB grates.
 3" for TW or TB grates.
 ** 2'-0" for LW-1, LB-1, TW-1 or TB-1 grates. 1'-6" for LW-2, LB-2, TW-2 or TB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.
 t = 6" when H is 8' or less; 8" when H is over 8'. (See Sect. B-B)

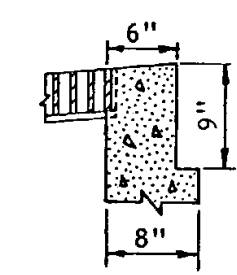
TABLE #1

H ₂	Support Angle size
4 1/16" to 8 3/16"	4"X4"X3/8"
8 1/4" to 9 3/16"	5"X5"X3/8"
9 1/4" to 10 1/16"	6"X6"X3/8"

Note: Fabricate entire assembly from 3/8" R. All square butt joints welded both sides using 3/8" fillets & 3/4" beads.



DETAIL #1
ADJUSTABLE CURB ASSEMBLY



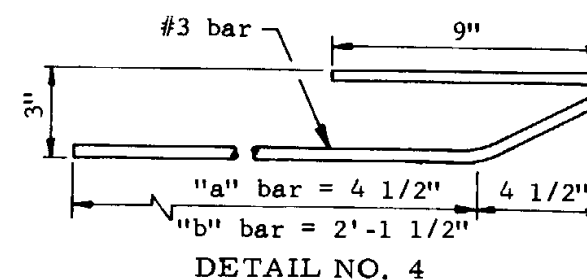
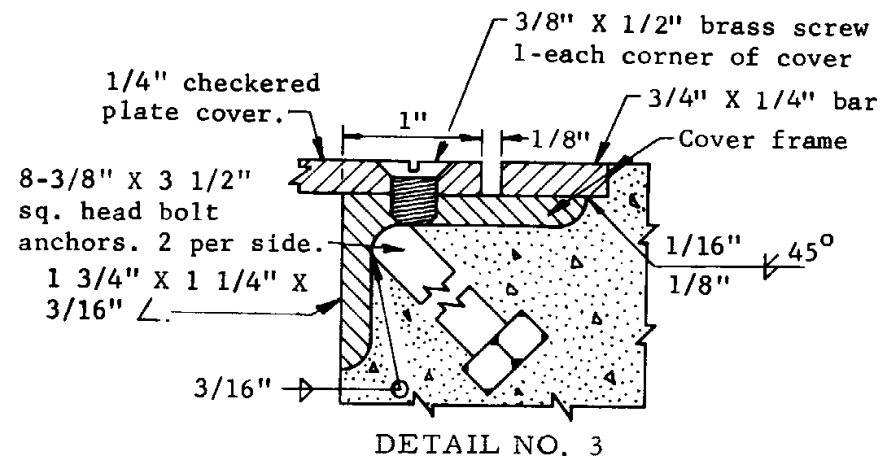
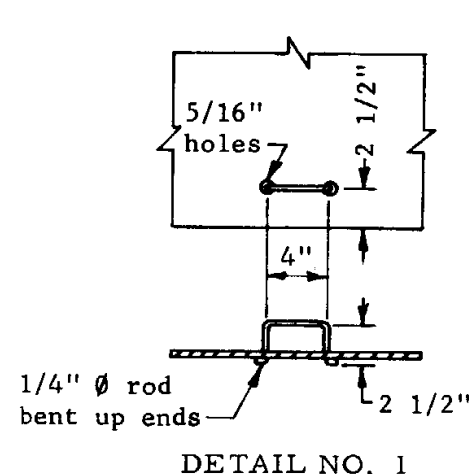
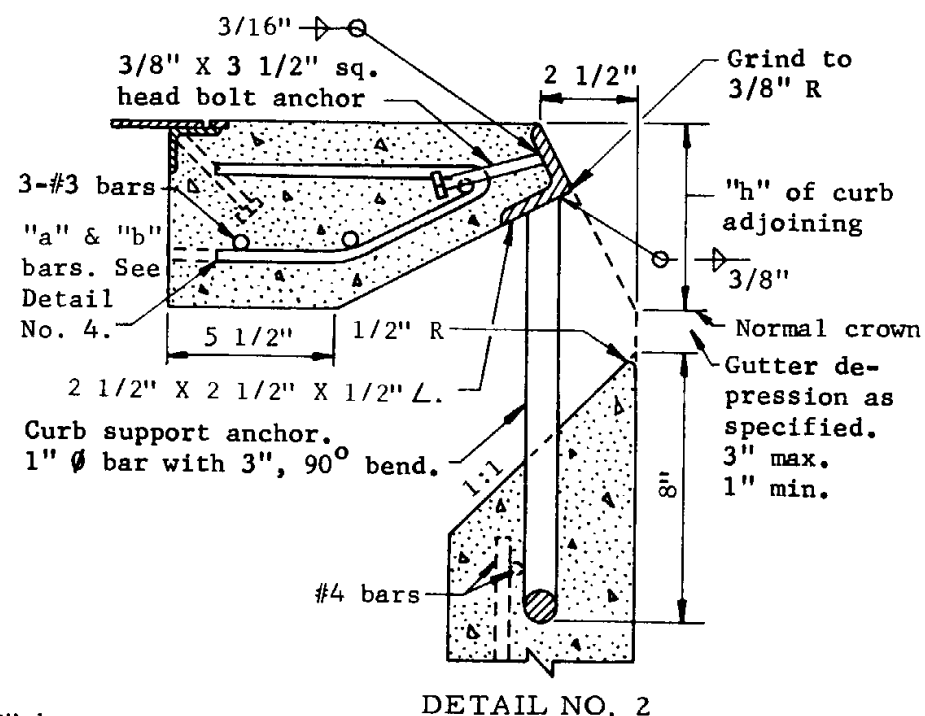
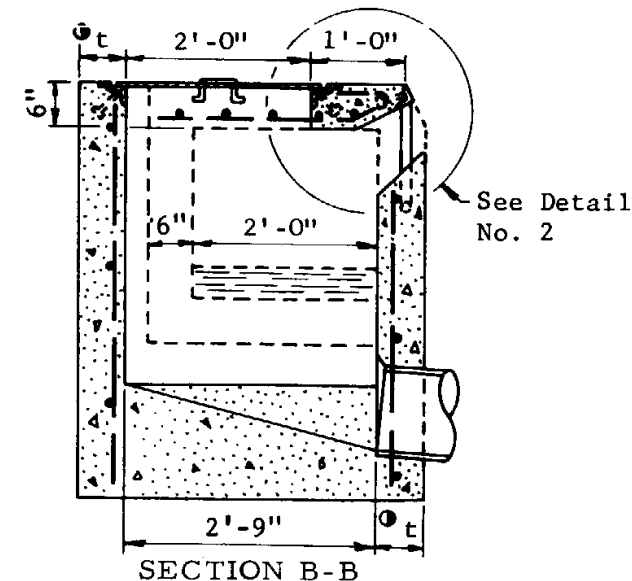
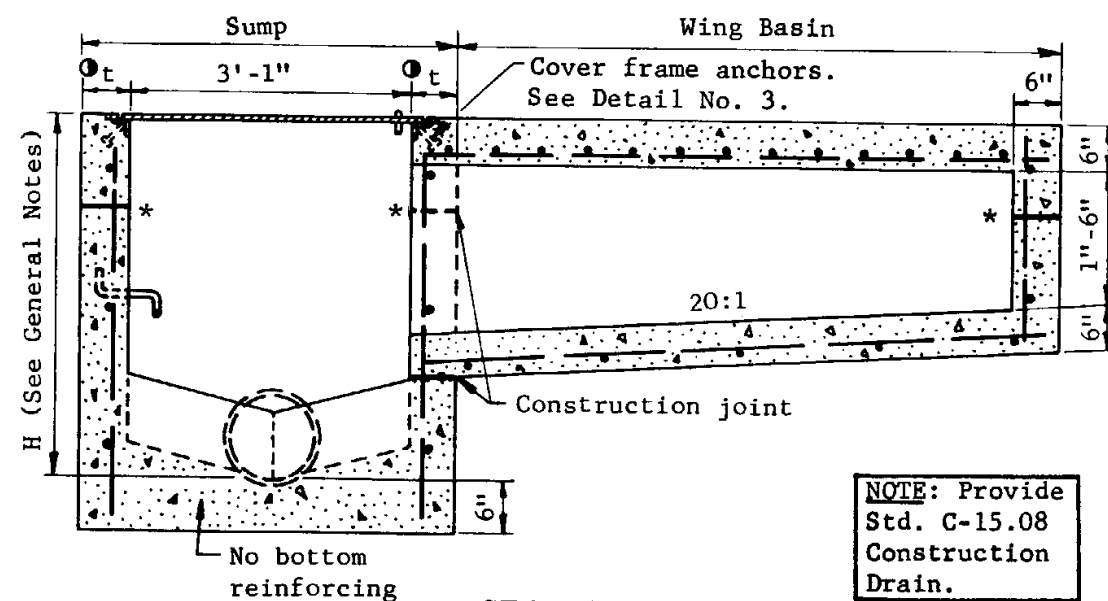
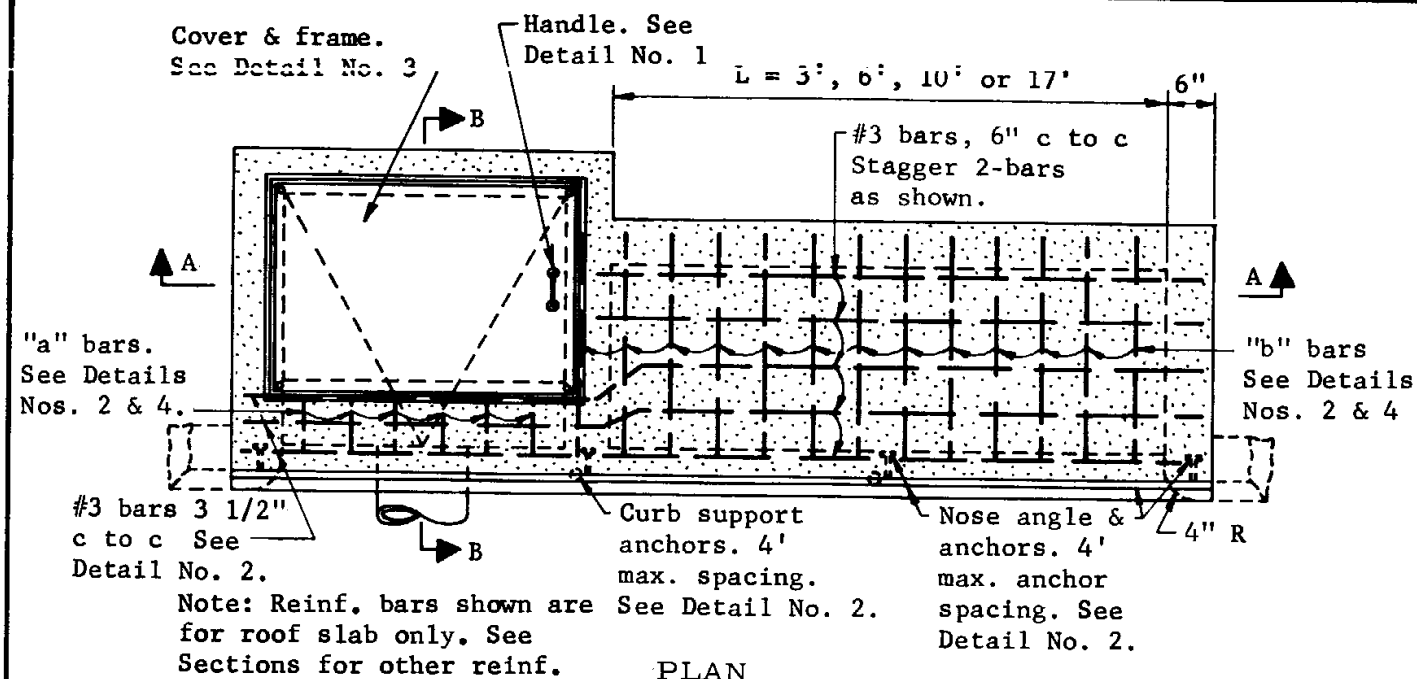
SECTION B-B

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

TYPE 2 CATCH BASIN

Drawn	D.G.	11-66	Drawing No. C-15.02
Traced	S.L.T.	6-67	
Checked	J.P.O.	9PO 5-68	
Approved Engr. Plans	H. H. H. 5-68		

Rev



GENERAL NOTES

C.B. 3 sump only.
C.B. 3-Wing (illustrated), sump with wing basin upstream.

C.B. 3-Double Wing, sump with symmetrical wing basins each side.

Pipes can be placed in any wall except wall adjacent to a wing basin.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be ASTM A 36.

Nose angle shall be given one shop coat of No. 1 paint.

All concrete shall be class A.

All reinforcing bars shall be #4, 1'-6" c to c both ways and 1 1/2" clear to inside of walls and outside of wing basin floor except as shown.

Curb opening area (Sq. Ft.) per inch of curb "h" + gutter depression = curb opening length (ft.) x 0.0834.

Welding shall be in accordance with A.H.D. Welding Manual.

* Construction joints at bottom of curb line.

Ø t = 6" when H = 8' or less
8" when H is greater than 8'.

H = 2'-10" min. when L = 3'
3'-0" min. when L = 6"
3'-2" min. when L = 10'
3'-7" min. when L = 17'

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

TYPE 3 CATCH BASIN

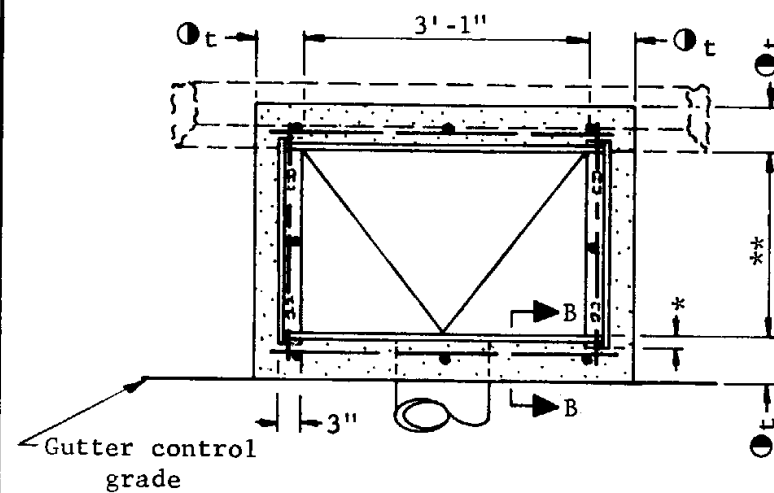
Drawn	D.G.	7-67
Traced	R.A.F.	7-67
Checked	J.P.O.	8PO 5-68
Approved		
Engr. Plans		8PO 5-68

Drawing No.

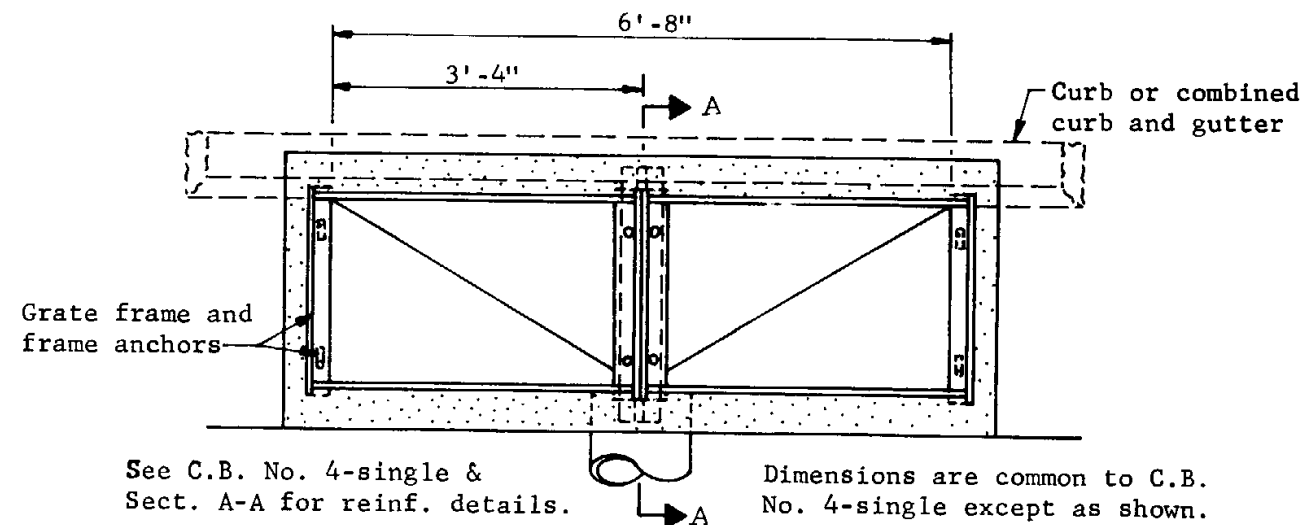
C-15.03

Rev

Miter frame sections 45°
butt weld and surface grind.

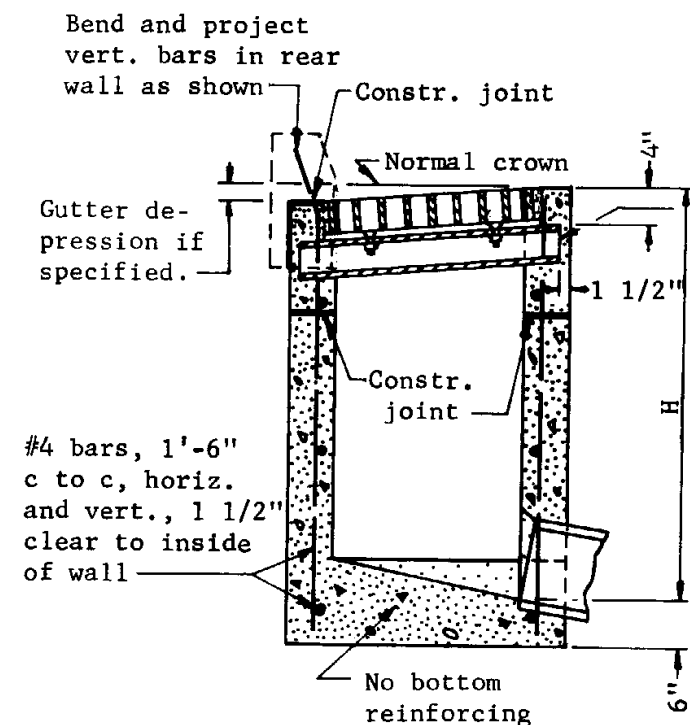


PLAN, CATCH BASIN NO. 4-SINGLE

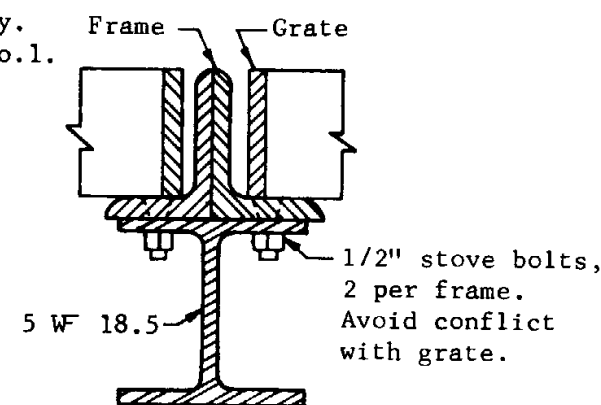


PLAN, CATCH BASIN NO. 4-DOUBLE

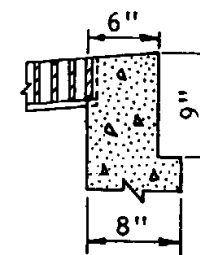
NOTE: Provide
Std. C-15.08
Construction
Drain.



SECTION A-A



DETAIL NO. 1



SECTION B-B

Use this section
when $t = 8''$

GENERAL NOTES

Pipes can be placed in any wall.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Curb over catch basin shall not be constructed until catch basin concrete has set for a minimum of 24 hours.

For grate and frame details and opening areas, see Stds. C-15.06 and C-15.07.

Any specified gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be ASTM A 36.

Grate support shall be given one shop coat of No. 1 paint.

All concrete shall be Class A.

* 3/4" for LW or LB grates.
3" for TW or TB grates.

** 2'-0" for LW-1, LB-1, TW-1 and TB-1 grates. 1'-6" for LW-2, LB-2, TW-2 and TB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

① $t = 6''$ when $H = 8'$ or less
8" when H is greater than 8'. (See Section B-B)

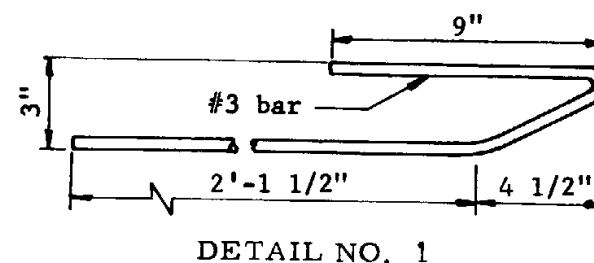
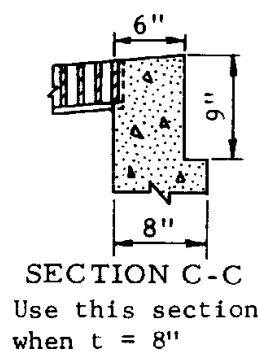
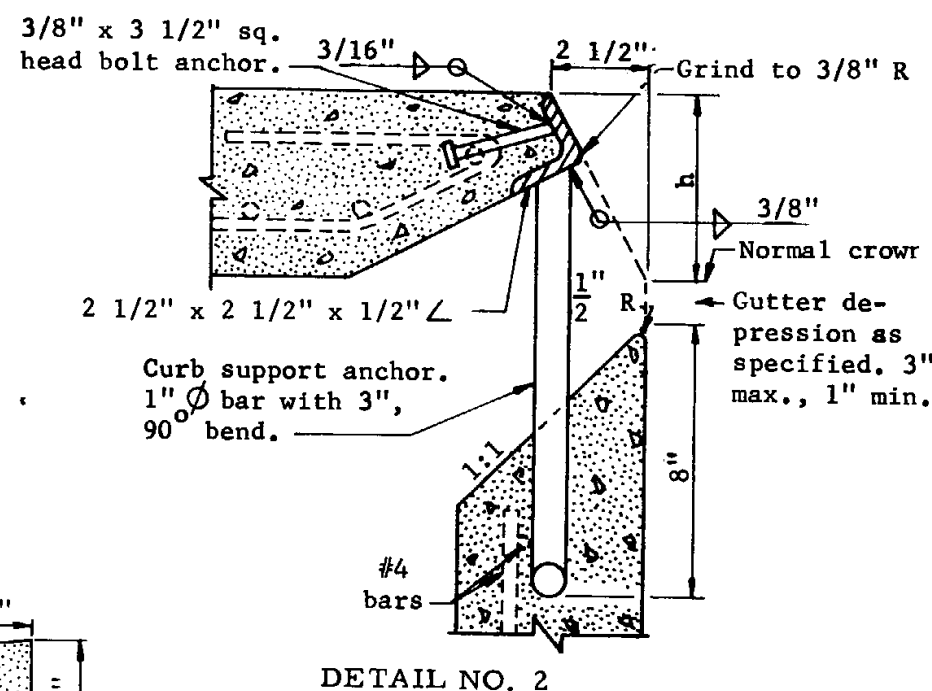
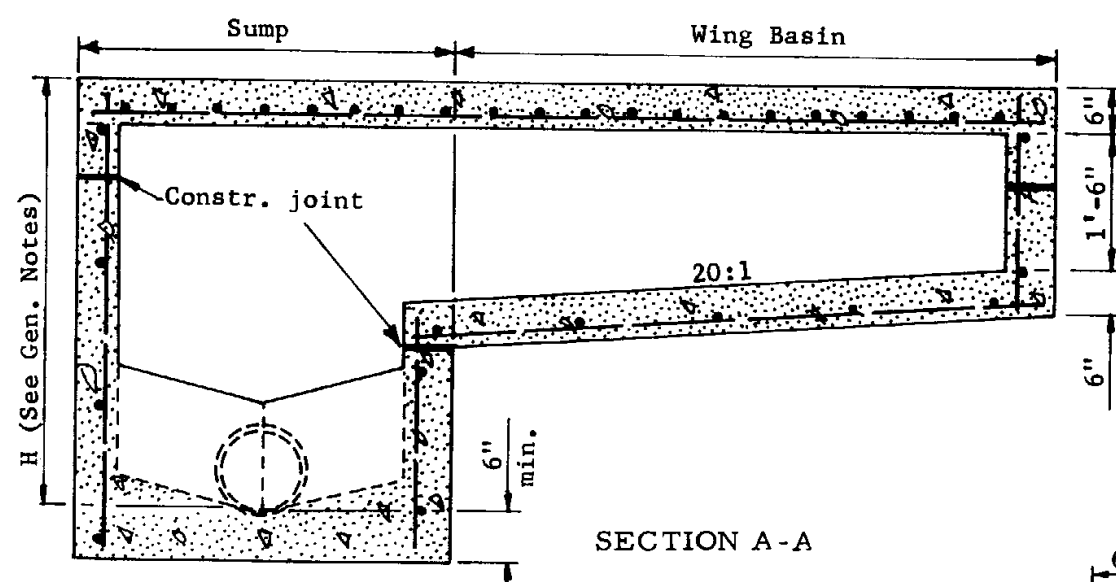
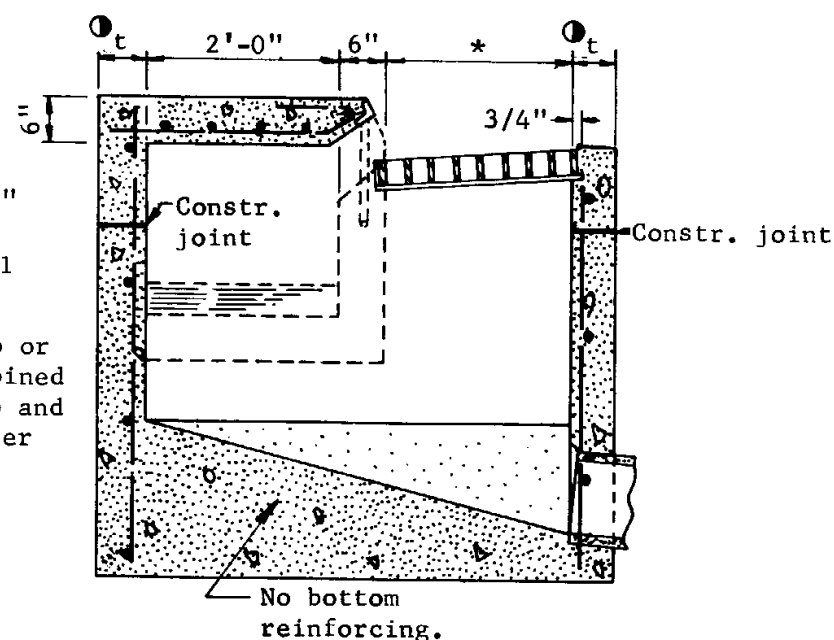
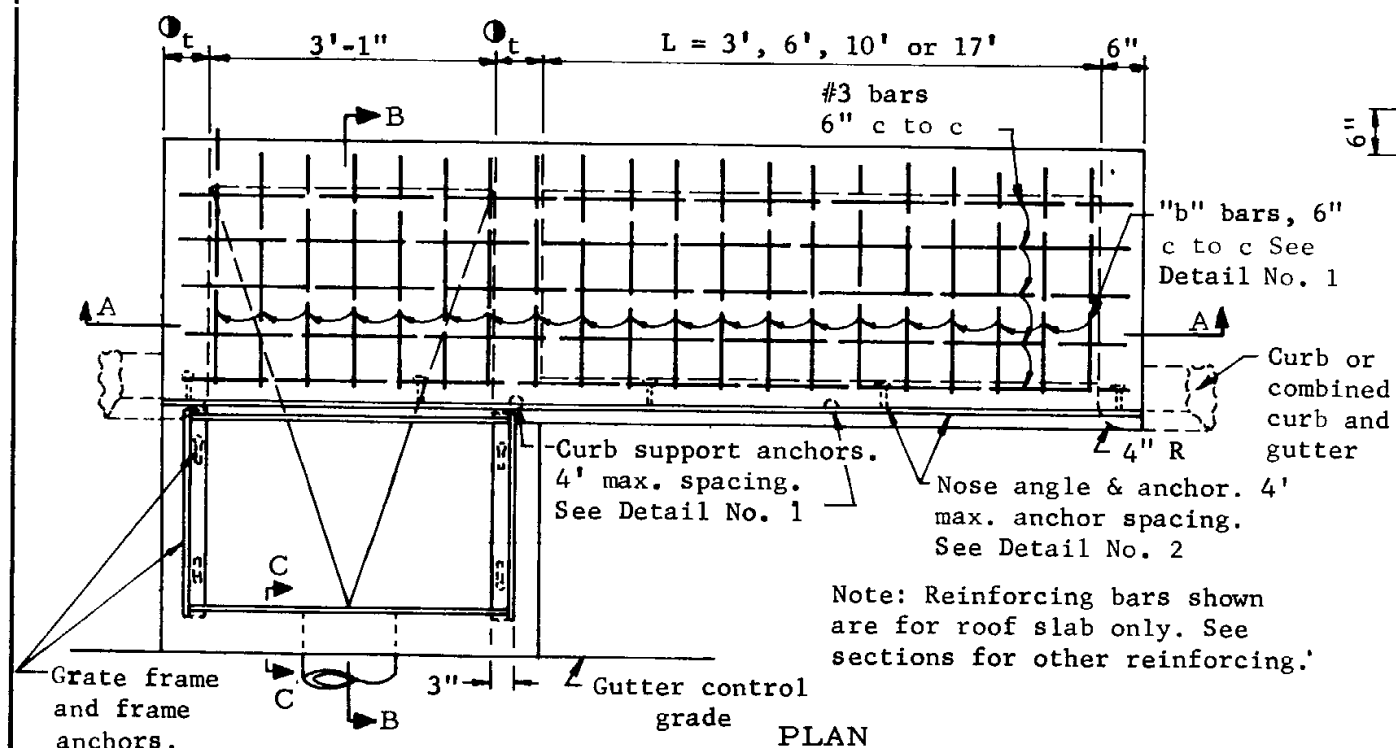
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

TYPE 4 CATCH BASIN

Drawn	D.G. 6-67
Traced	S.L.T. 7-67
Checked	J.P.O. 8PD 5-68
Approved	
Engr. Plans	5-68

Drawing No.
C-15.04

Rev



GENERAL NOTES

C.B. 5, sump only.

C.B. 5 Single, (illustrated), sump with wing basin upstream.

C.B. 5 Double, sump with symmetrical wing basins each side.

Pipes can be placed in any wall except wall adjacent to a wing basin.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Welding shall be in accordance with A.H.D. Welding Manual.

Gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be in accordance with ASTM A 36.

Nose angle shall be painted with one No. 1 shop coat.

All concrete shall be Class A.

All reinforcing bars shall be #4, 18" c to c both ways and 1 1/2" clear to inside of walls and outside of wing basin floor except as shown.

Curb opening area (Sq. Ft.) per inch of curb "h" + gutter depression = curb opening length (Ft.) X 0.0834.

For grate and frame details and opening areas, see Stds. C-15.06 and C-15.07.

t = 6" when H = 8' or less; 8" when H is greater than 8'. (See Section C-C)

*2'-0" for LW-1 and LB-1 grates; 1'-6" for LW-2 and LB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

H = 3'-3" min. when L = 3'

3'-5" min. when L = 6'

3'-7" min. when L = 10'

4'-0" min. when L = 17'

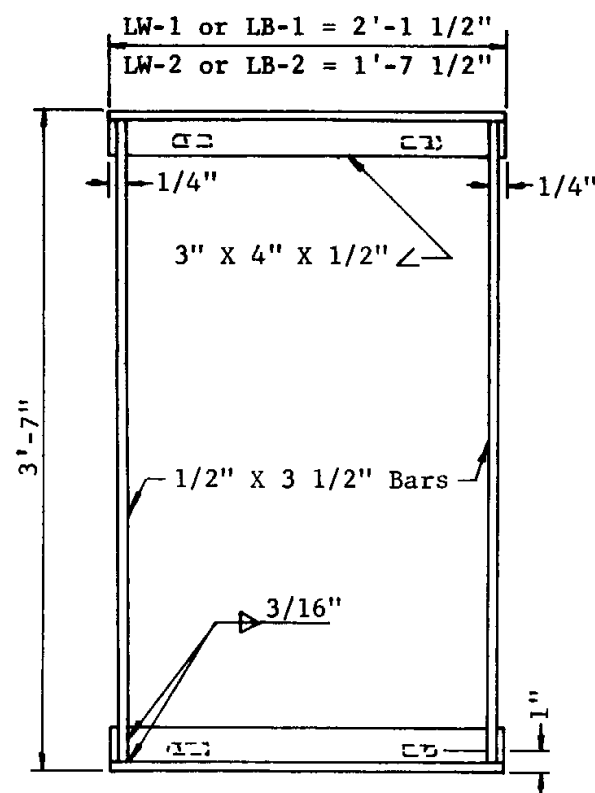
NOTE: Provide Std. C-15.08 Construction Drain.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

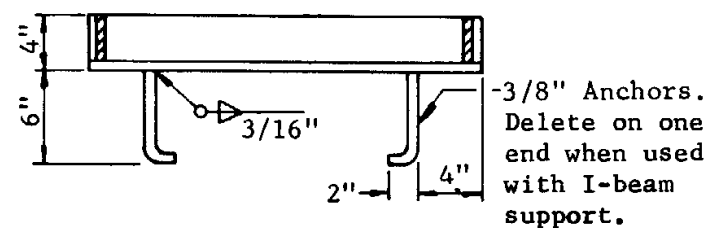
TYPE 5 CATCH BASIN

Drawn	D.G. 7-67	Drawing No.
Traced	S.L.T. 7-67	C-15.05
Checked	J.P.O. 8PO 5-68	
Approved	Y. Kleider 15-68	
Ingr. Plans		

Rev

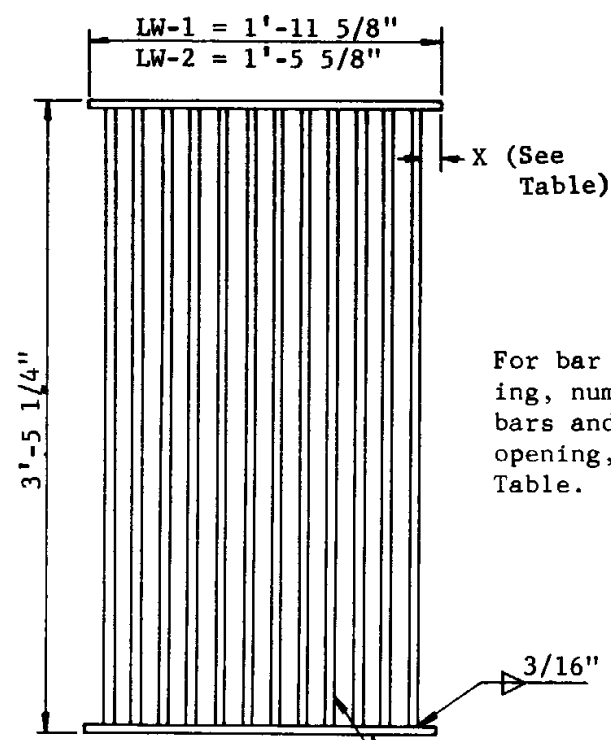


PLAN

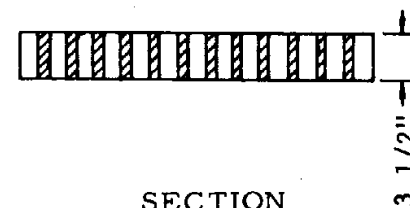


SECTION

FRAME



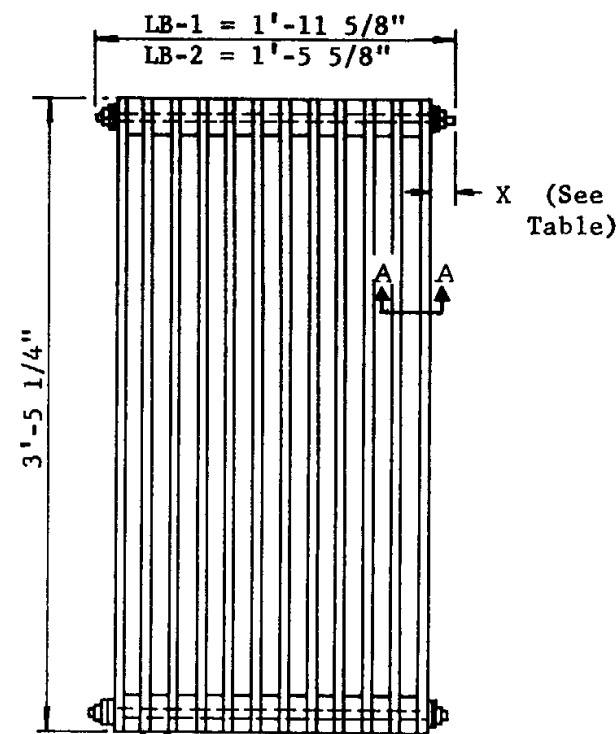
PLAN



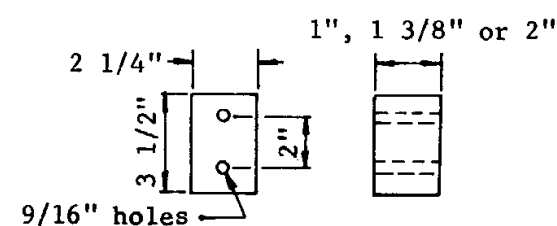
SECTION

GRATE TYPES LW-1 & LW-2

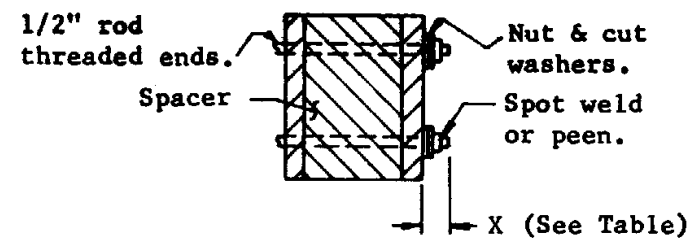
Restricted to use on longitudinal grades of 3% and less.



PLAN



BAR SPACER DETAIL
Cast iron, cast steel or
steel bar stock.



SECTION A-A

GRATE TYPES LB-1 & LB-2
For use on longitudinal grades
in excess of 3% or as an alter-
nate to Type LW on grades of 3%
or less.

GENERAL NOTES
Grating units and frames shall
be fabricated from structural steel
except as noted. Structural steel
shall be in accordance with ASTM A
36.

Welding shall be in accordance
with A.H.D. Welding Manual.

The completed assembly shall
be given one shop coat of No. 1
paint.

LW indicates longitudinal welded.
LB indicates longitudinal bolted.

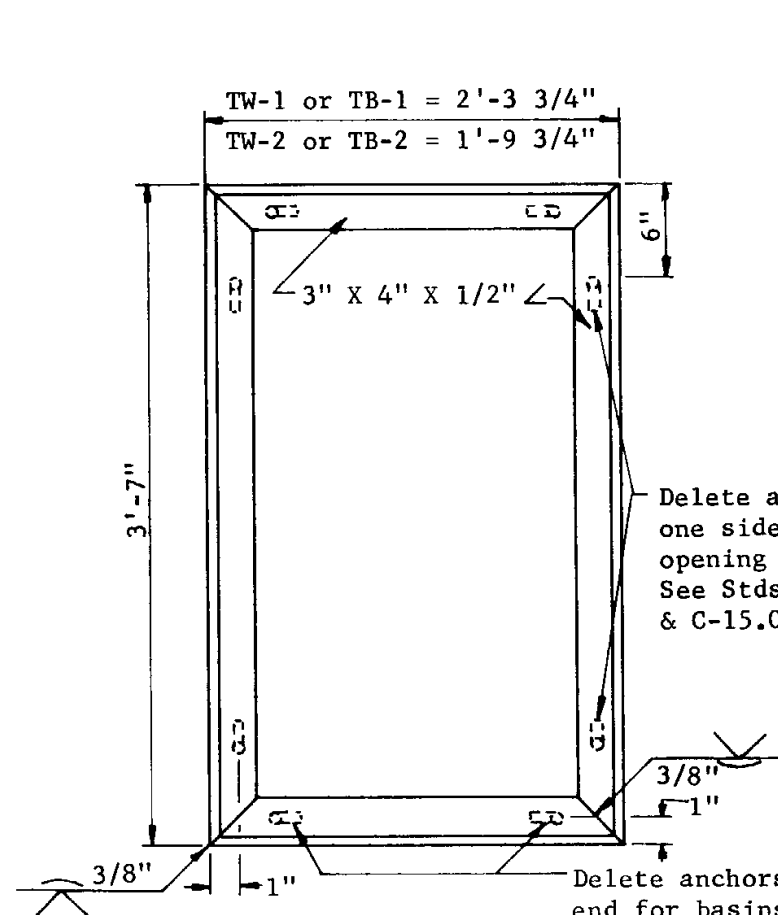
Type	Clear Spacing	No. Bars	X	Grate Opening Sq. Ft.
LW or LB-1.0	1"	16	5/16"	4.58
LW or LB-1.1	1 3/8"	12	1 1/4"	4.99
LW or LB-1.2	2"	9	1 9/16"	5.41
LW or LB-2.0	1"	12	5/16"	3.47
LW or LB-2.1	1 3/8"	9	1 1/16"	3.75
LW or LB-2.2	2"	7	1 1/16"	4.03

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

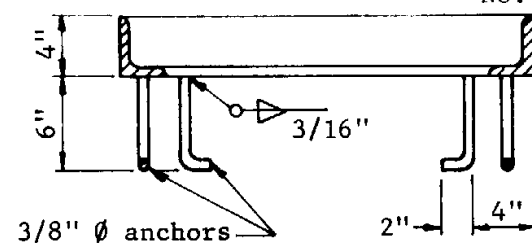
CATCH BASIN GRATE
LB AND LW GRATES

Drawn	D.G. 7-66	Drawing No. C-15.06
Traced	S.L.T. 7-67	
Checked	J.P.O. 870 5-68	
Approved Engr. Plans	J. Heidecker 5-68	

Rev

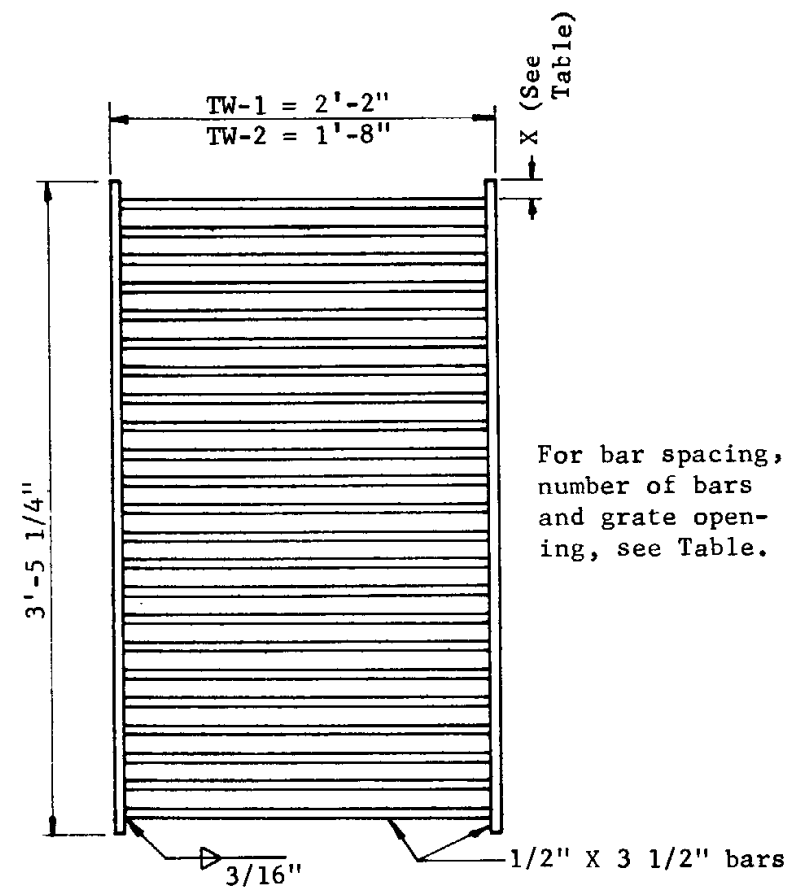


PLAN

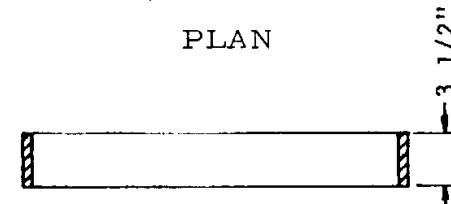


SECTION

FRAME

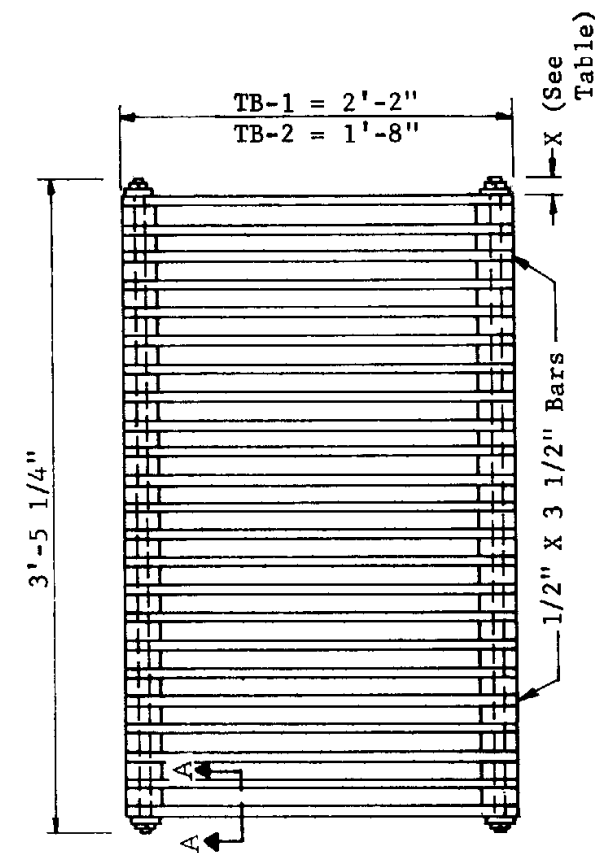


PLAN

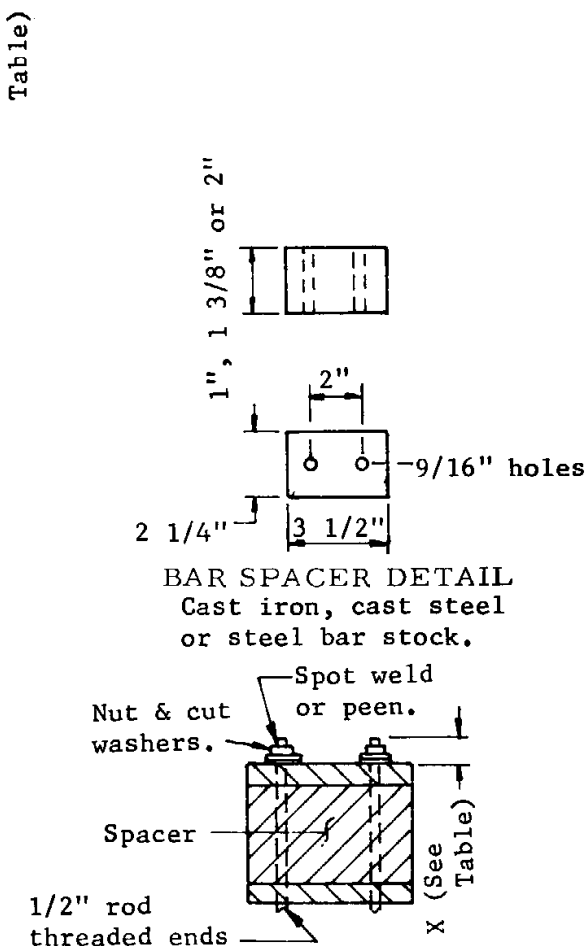


SECTION

GRATE TYPES TW-1 & TW-2



PLAN



SECTION A-A

GRATE TYPES TB-1 & TB-2

GENERAL NOTES

Grating units and frames shall be fabricated from structural steel except as noted. Structural steel shall be in accordance with ASTM A 36.

Welding shall be in accordance with A.H.D. Welding Manual.

The completed assembly shall be given one shop coat of No. 1 paint.

TW indicates transverse welded.
TB indicates transverse bolted.

Type	Clear Spacing	No. Bars	X	Grate Opening Sq. Ft.
TW or TB-1.0	1"	28	7/8"	3.47
TW or TB-1.1	1 3/8"	22	11/16"	3.93
TW or TB-1.2	2"	16	1 5/8"	4.31
TW or TB-2.0	1"	28	7/8"	2.51
TW or TB-2.1	1 3/8"	22	11/16"	2.83
TW or TB-2.2	2"	16	1 5/8"	3.11

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

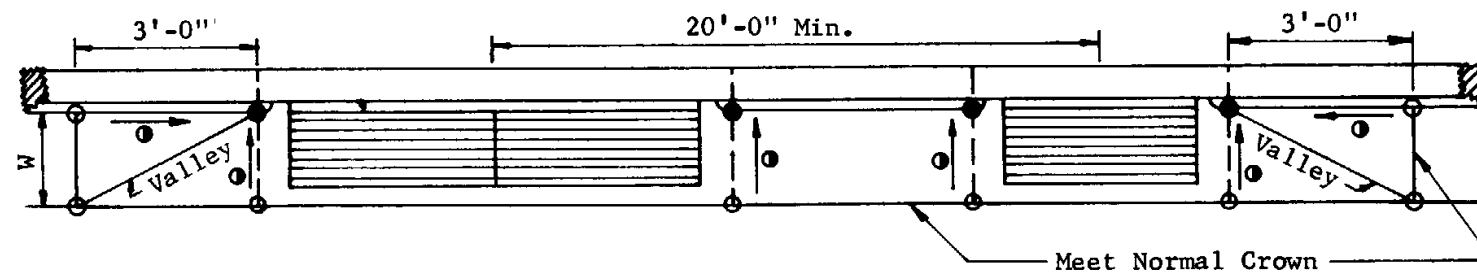
CATCH BASIN GRATE TB AND TW GRATES

Drawn	D.G. 6-67
Traced	S.L.T. 7-67
Checked	J.P.O. 8PO 5-68
Approved Engr. Plans	<i>[Signature]</i> 5-68

Drawing No.

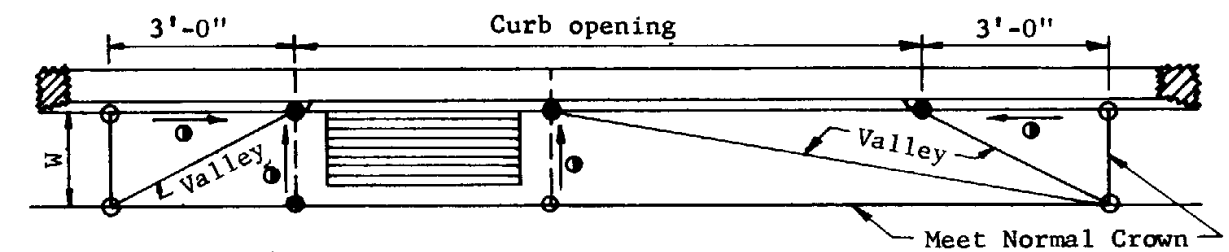
C-15.07

Rev

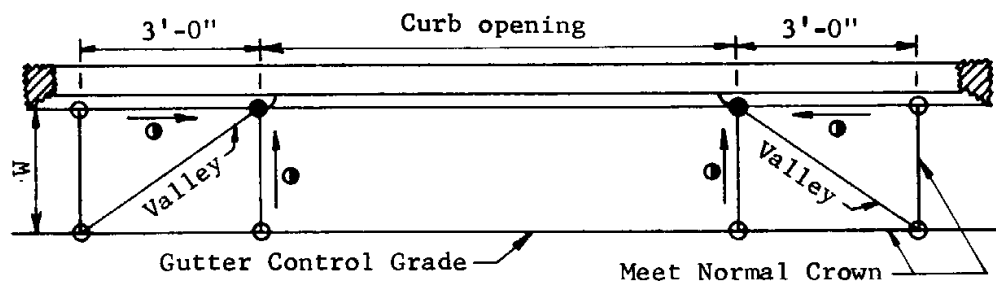


CATCH BASIN TYPES 1, 2, 4-SINGLE, 4-DOUBLE & 5-SINGLE

(Grate opening only or combination; showing minimum spacing for Catch Basins in series.)

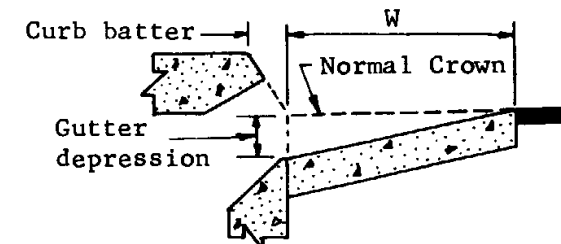


CATCH BASIN TYPES 5-SINGLE & 5-DOUBLE



CATCH BASIN TYPE 3

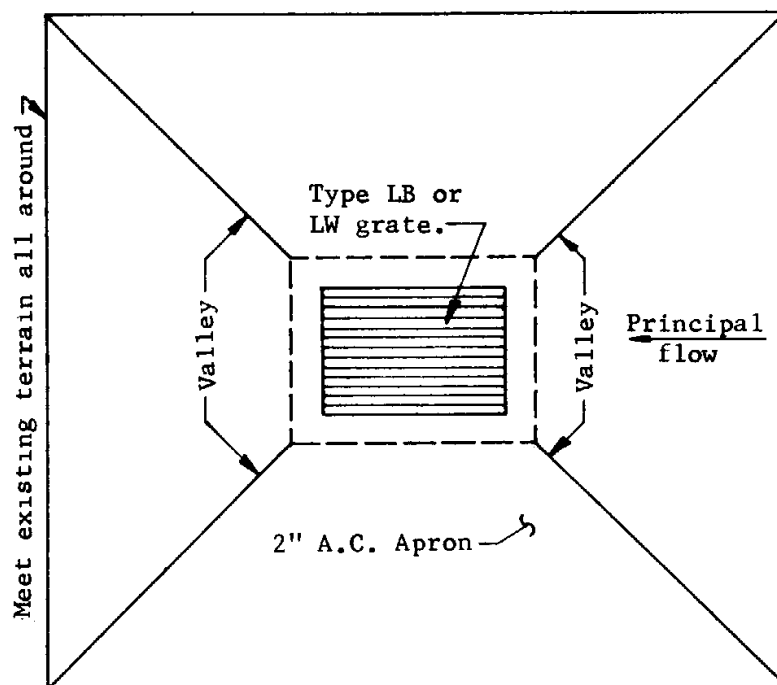
(Curb opening only.)



DETAIL NO. 1

LEGEND

- Gutter depression: 3" max. (See Detail No. 1)
- O = Normal crown or gutter flow line elevation.
- = Depressed elevation.
- = Straight grade with downward slope.
- W = Normal gutter width per Std. C-5.01

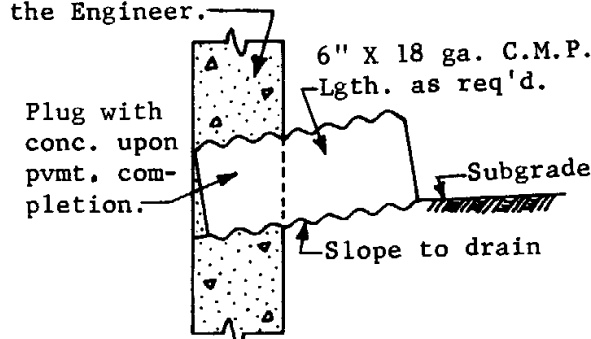


CATCH BASIN TYPE 4

(Off roadway location)

Apron shall be shaped to suit local conditions and shall extend a minimum of 4'-0" from edge of grate in all directions. Grate shall be depressed a minimum of 4" below surrounding terrain and bars shall parallel direction of principal flow.

*Catch basin wall as specified by the Engineer.



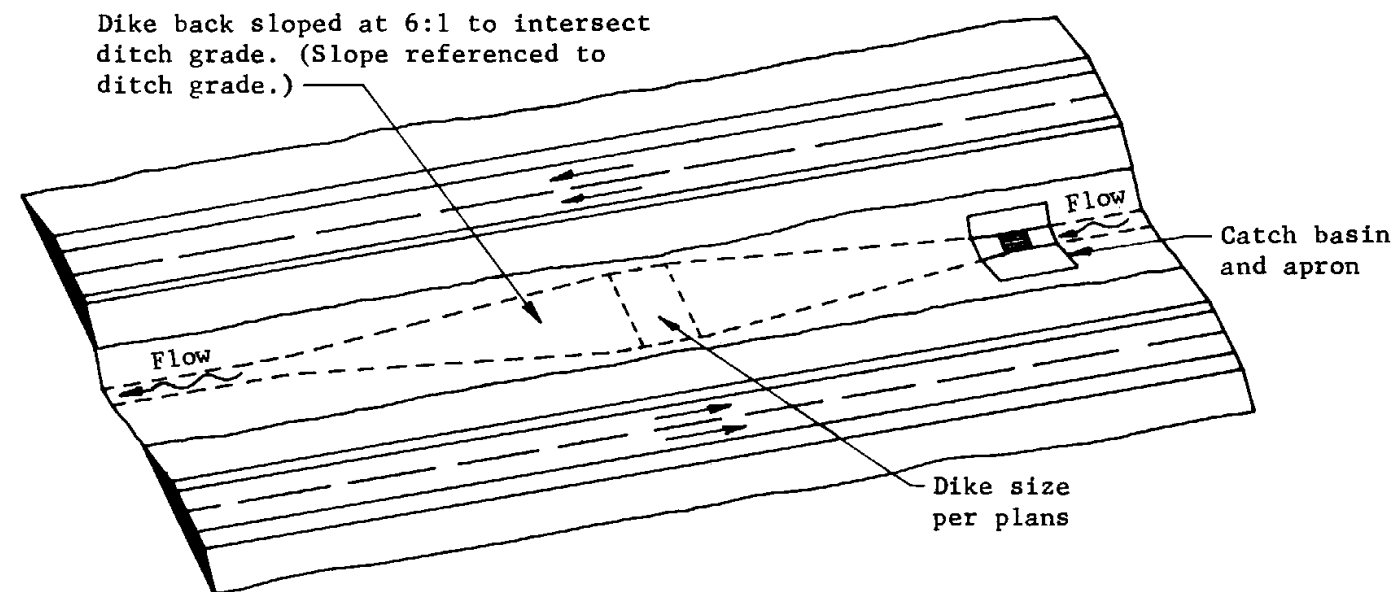
CATCH BASIN CONSTRUCTION DRAIN

*Drain may be deleted at option of Engineer

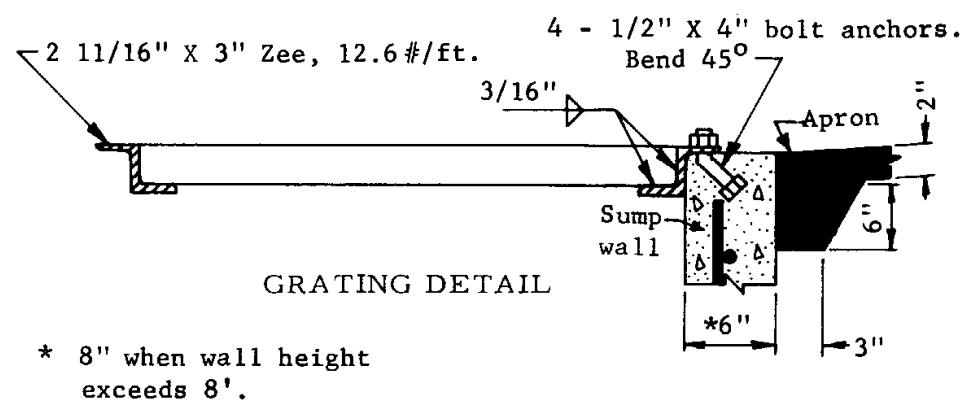
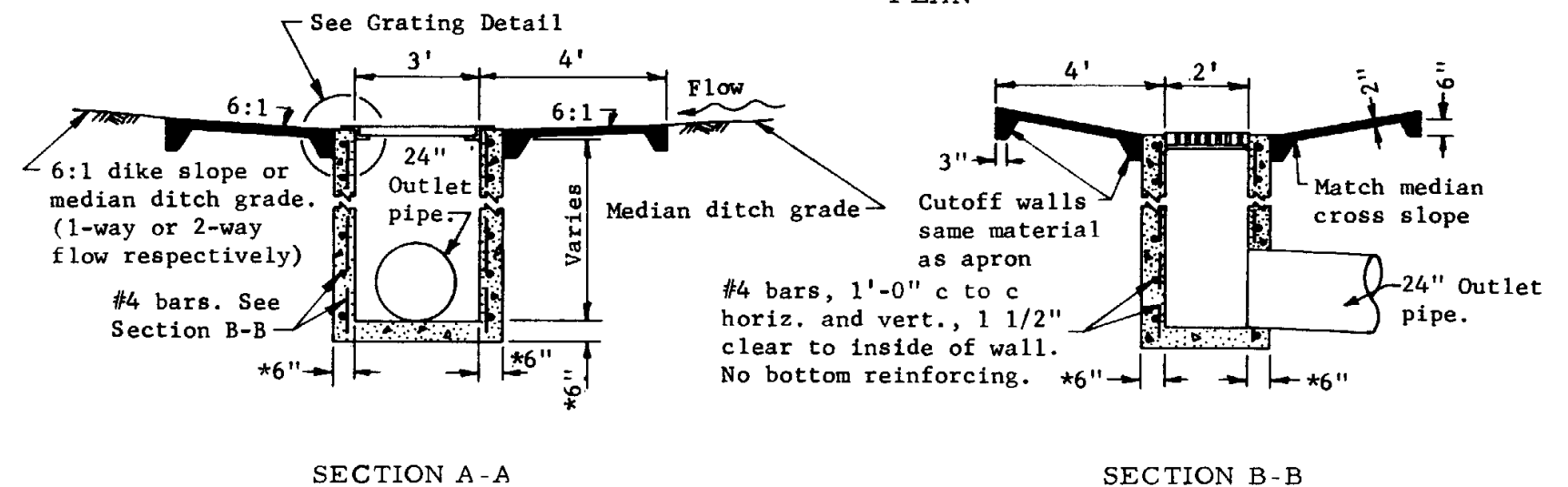
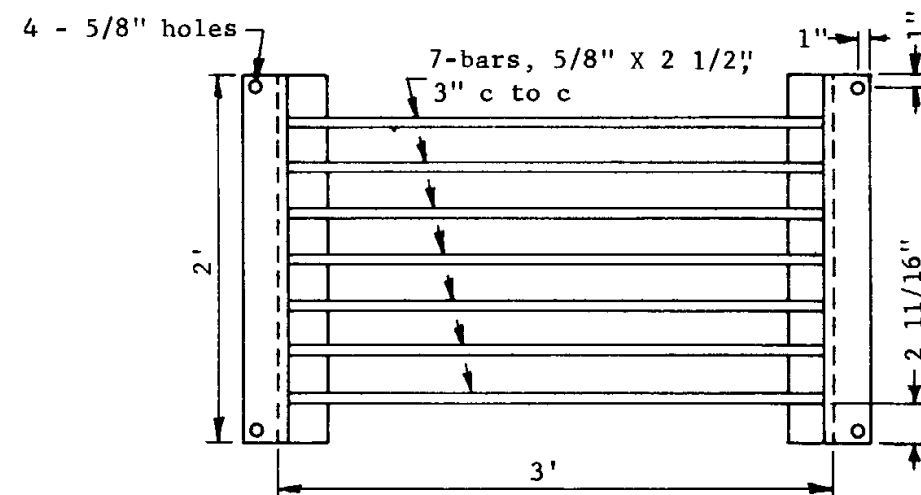
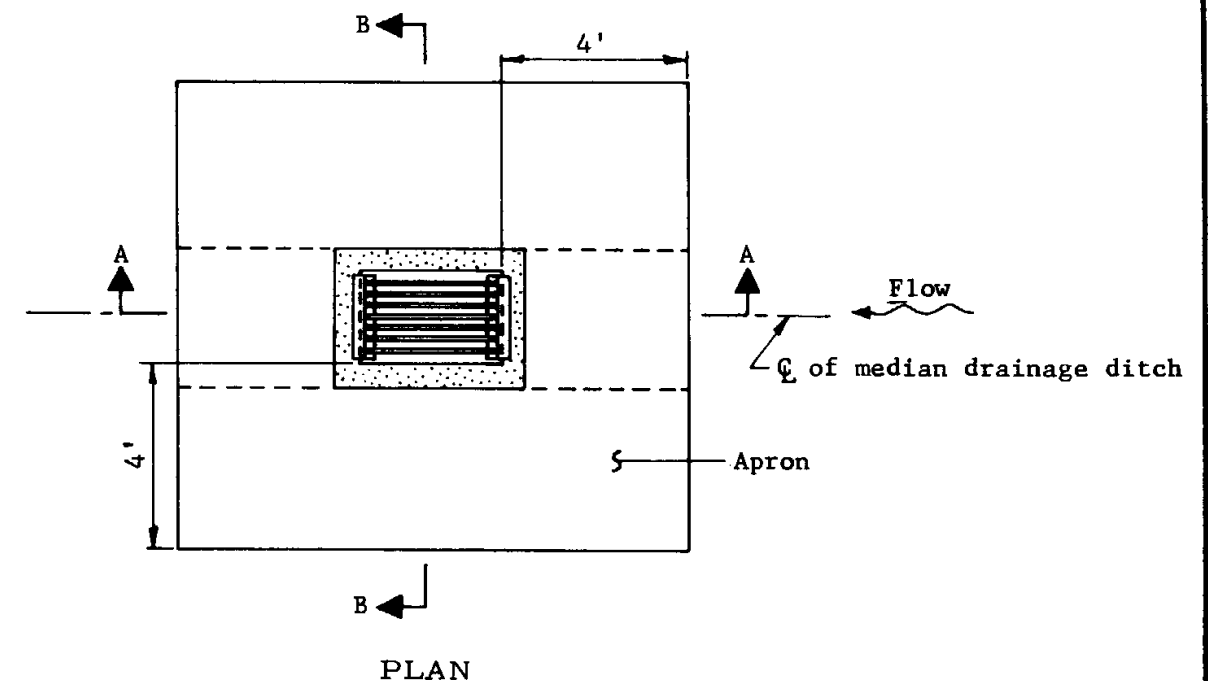
GENERAL NOTES

No gutter depression shall be used adjacent to median.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CATCH BASIN DEPRESSED APRON & CONSTRUCTION DRAIN			
Drawn	S.L.T. 10-67	Drawing No. C-15.08	
Traced	S.L.T. 10-67		
Checked	J.P.O. <i>9PD 5-68</i>		
Approved Engr. Plans	<i>M. Heidecker 5-68</i>		



PLAN PERSPECTIVE
ILLUSTRATING 1-WAY FLOW WITH DYKE



GENERAL NOTES

Apron shall be A. C. or P. C. concrete as specified on Plans.

Concrete shall be Class A.

Grating shall be fabricated of structural steel. Structural steel shall be in accordance with ASTM A 36.

Welding shall be in accordance with A.H.D. Welding Manual.

Grating assembly shall be given one shop coat of No. 1 paint.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

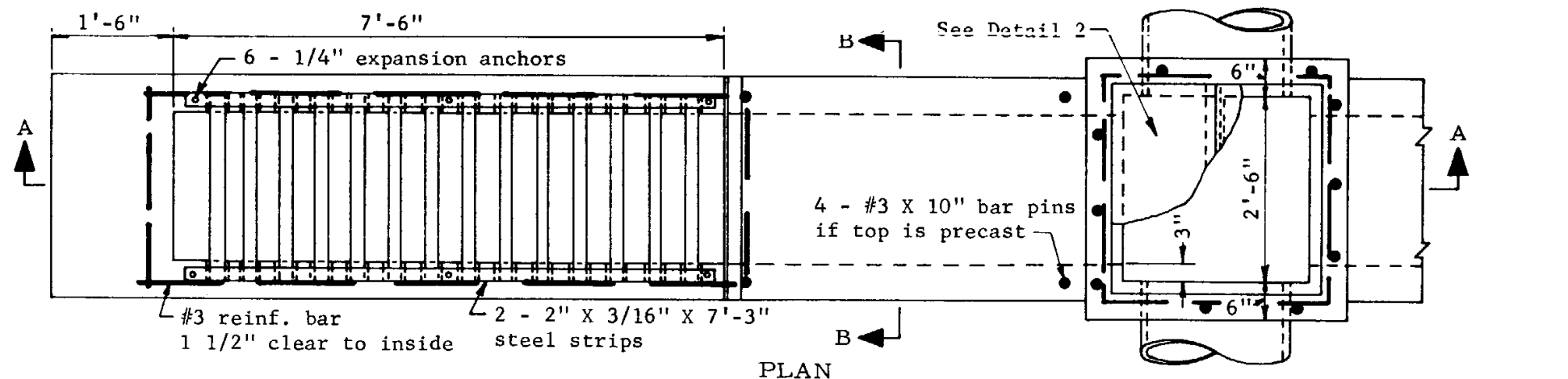
MEDIAN CATCH BASIN

Drawn	D.G. 3-68
Traced	R.A.F. 3-68
Checked	J.P.O. 8PD 5-68
Approved Engr. Plans	<i>[Signature]</i> 5-68

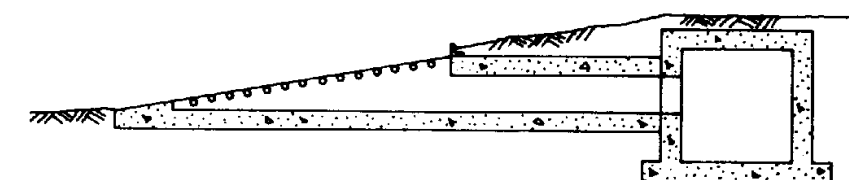
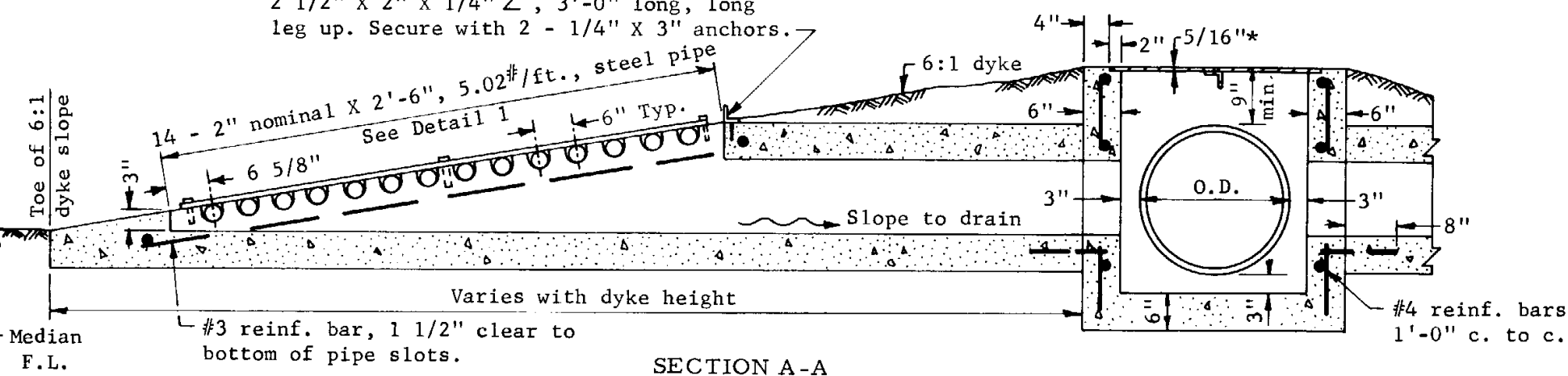
Drawing No.

C-15.09

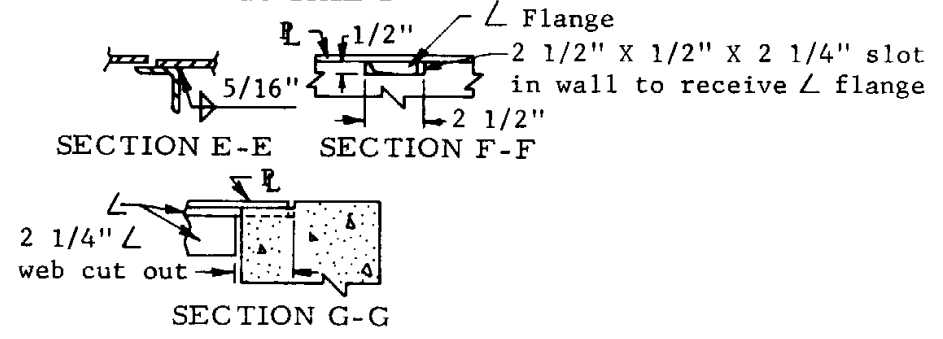
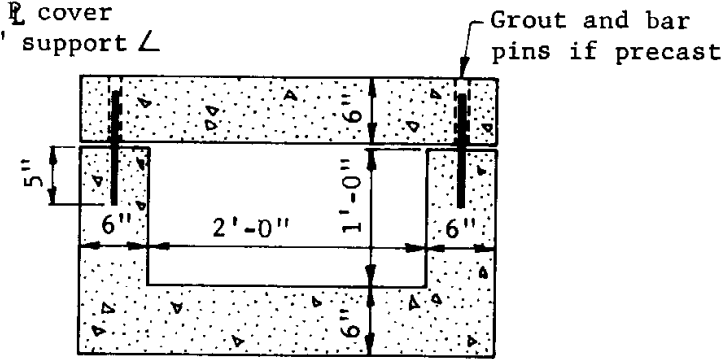
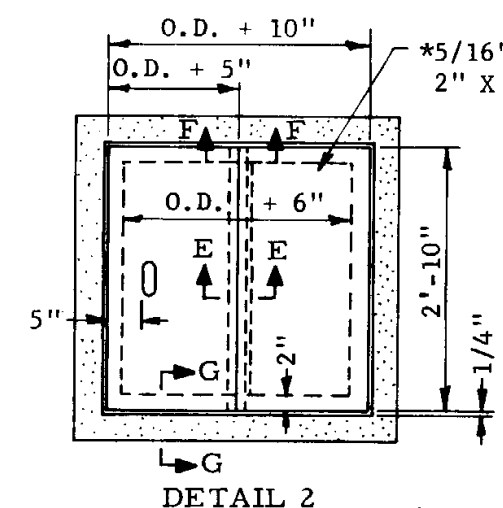
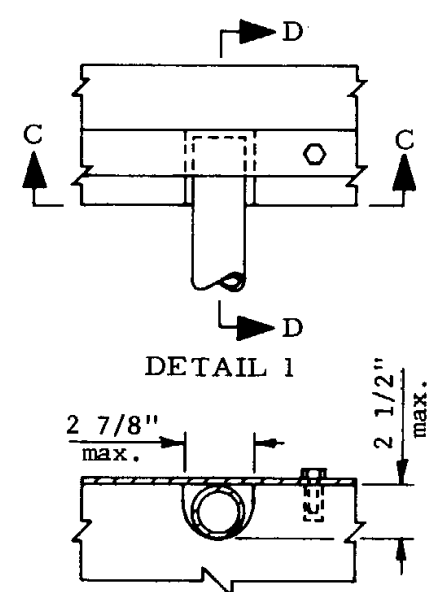
Rev



2 1/2" X 2" X 1/4" ∠, 3'-0" long, long leg up. Secure with 2 - 1/4" X 3" anchors.



INLET TO BOX CULVERT
(See Bridge sheets for details)



GENERAL NOTES

All concrete shall be Class A.

Steel pipe, plate and strip shall be in accordance with ASTM A 36.

Exposed steel shall be given one shop coat of No. 1 paint.

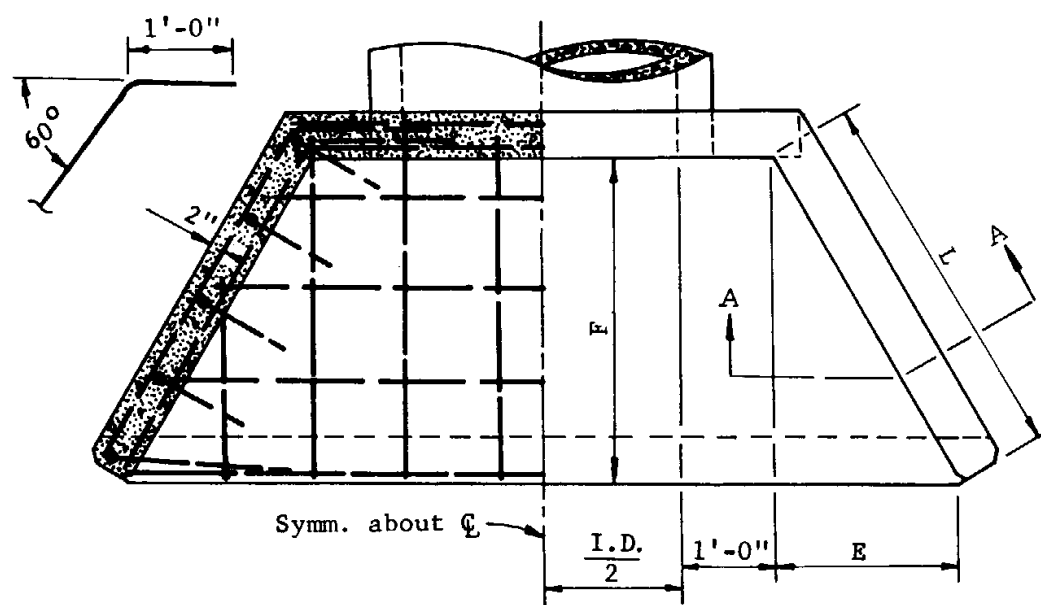
*When O.D. + 5" exceeds 1'-11", use 3/8" plate.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

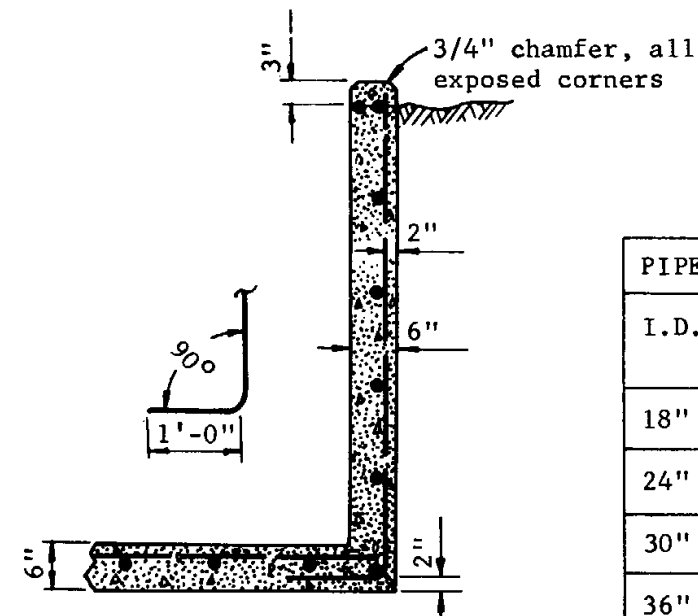
MEDIAN DYKE
CATCH BASIN

Drawn	D.G. 3-68	Drawing No. C-15.10
Traced	R.A.F. 4-68	
Checked	J.P.O. 9PO 5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

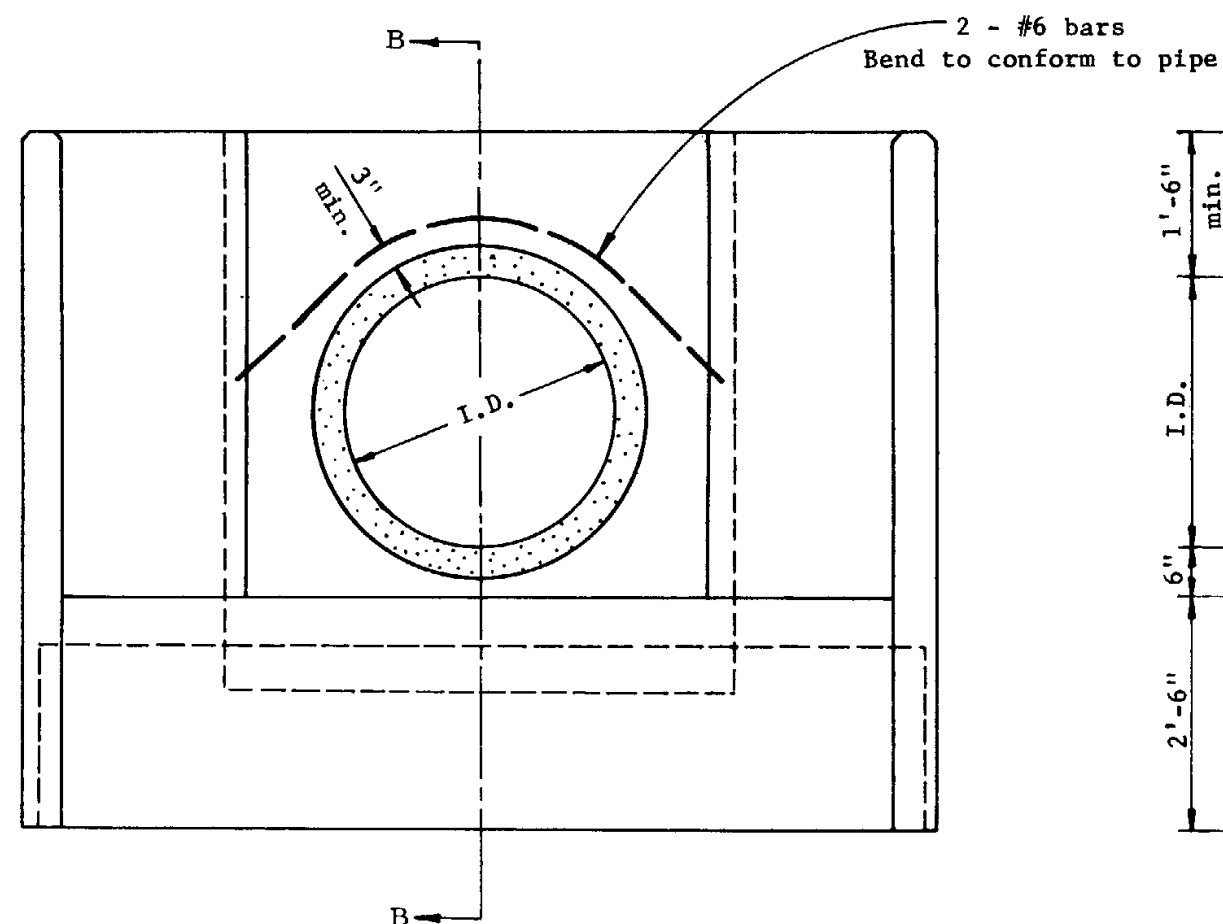


PLAN

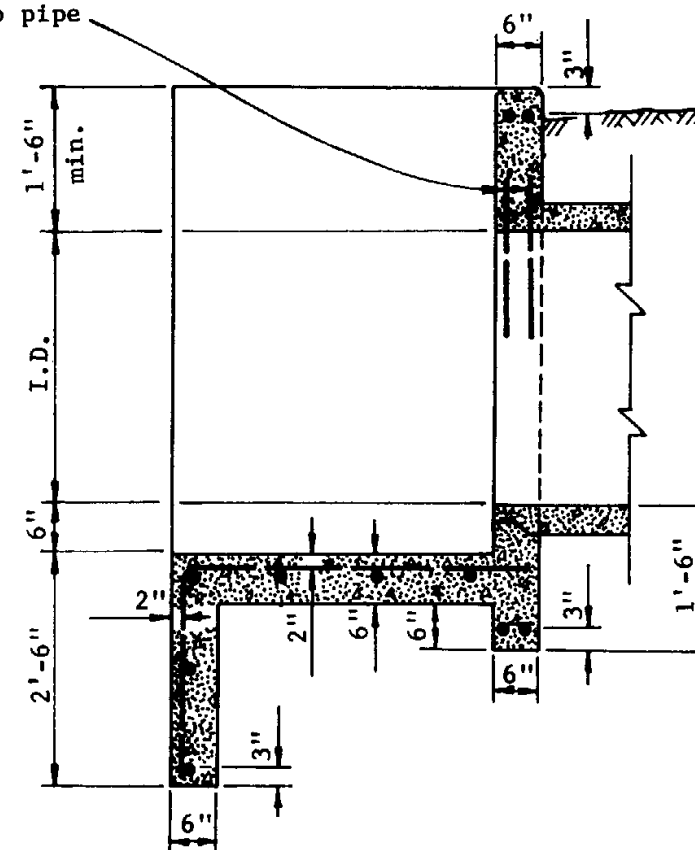


SECTION A-A

PIPE I.D.	DIMENSIONS			QUANTITIES		
	L	E	F (Approx)	C.Y. Conc.		Reinf. Steel Lbs.
18"	2'-0"	1'-0"	1'-9"	0.97	0.96	65
24"	2'-0"	1'-0"	1'-9"	1.11	1.07	78
30"	3'-0"	1'-6"	2'-7"	1.50	1.44	108
36"	4'-0"	2'-0"	3'-6"	2.08	2.01	150
42"	5'-0"	2'-6"	4'-4"	2.71	2.63	205
48"	6'-0"	3'-0"	5'-2"	3.39	3.30	270
54"	7'-0"	3'-6"	6'-1"	4.14	4.02	335
60"	8'-0"	4'-0"	6'-11"	4.96	4.80	410



ELEVATION



SECTION B-B

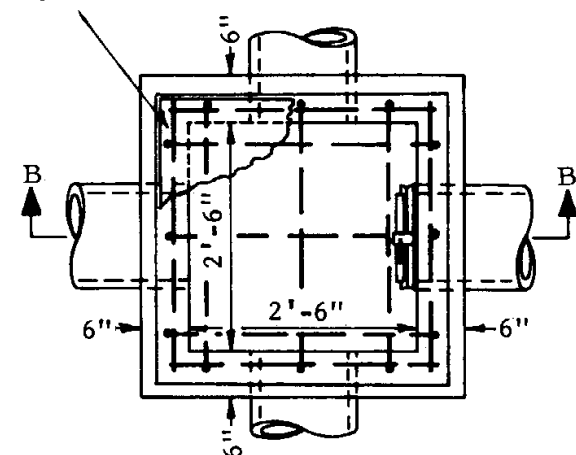
GENERAL NOTES

All concrete shall be Class A.

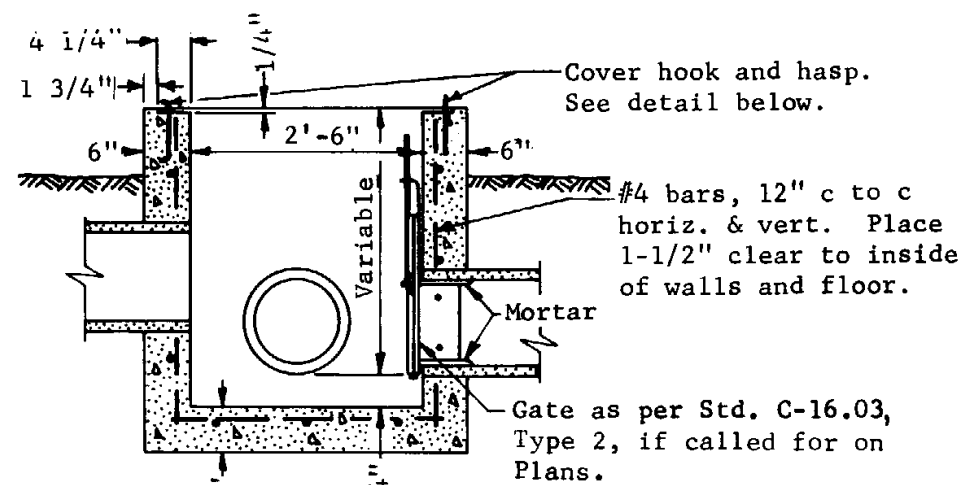
All reinforcing bars shall be #4 except two #6 bars over pipe. Bar spacing approximately 1'-0" c to c unless otherwise noted.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
IRRIGATION HEADWALLS 18" TO 60" DIAMETER PIPES			
Drawn	R.J.J. 3-10-58	Drawing No. C-16.01	
Traced	S.L.T. 5-4-67		
Checked	J.P.O. <i>9PD 5-68</i>		
Approved Engr. Plans	<i>W. Weidacher 5-68</i>		

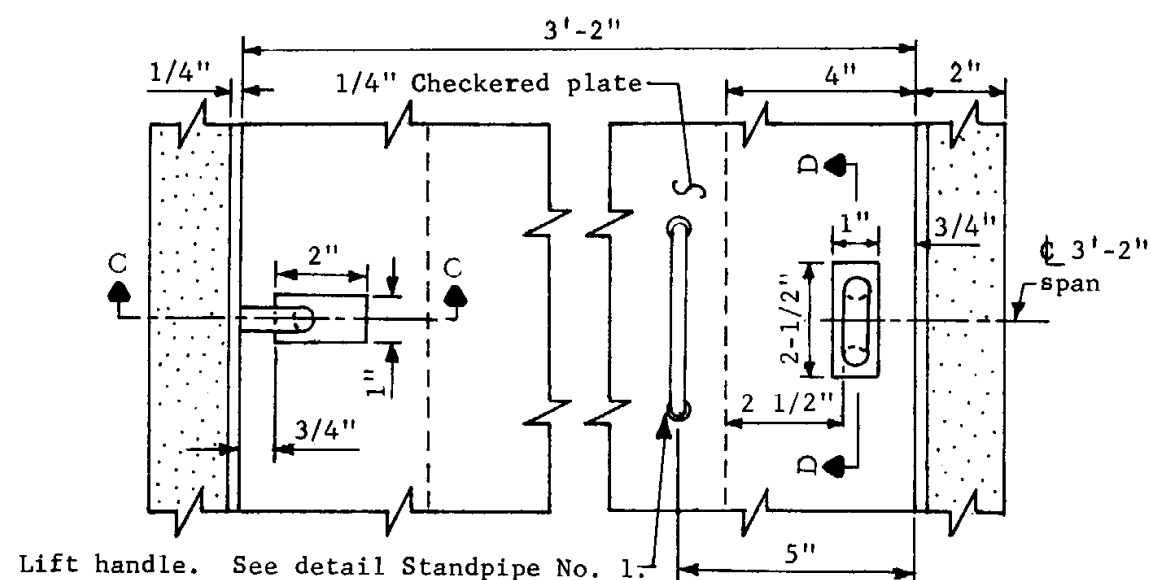
Cover. See detail below.



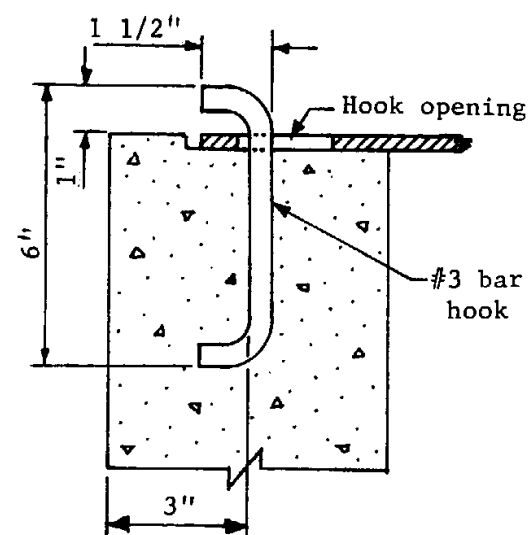
PLAN



SECTION B-B

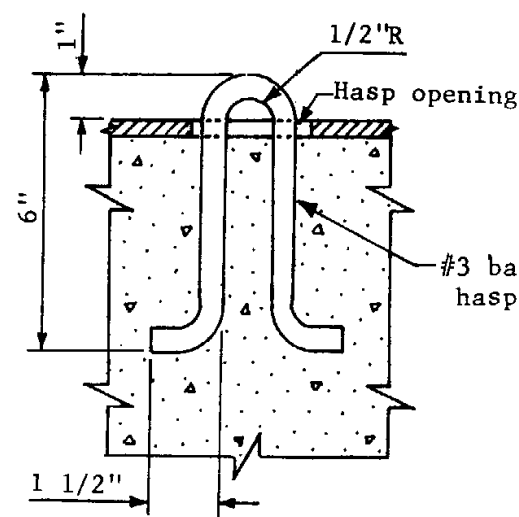


PLAN-LOCKING COVER



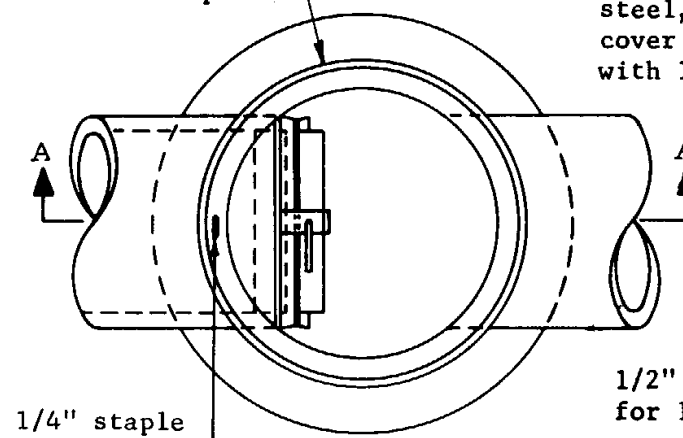
SECTION C-C

IRRIGATION STANDPIPE NO. 2



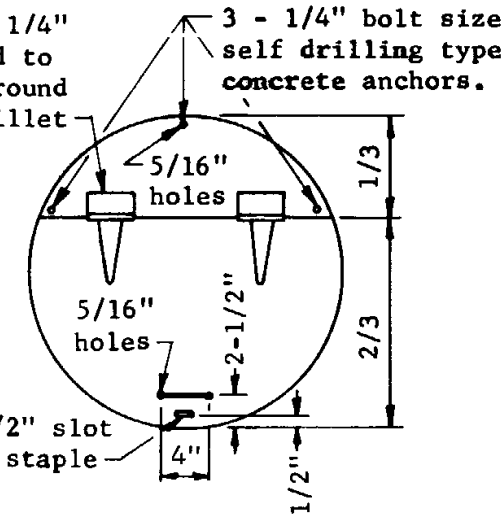
SECTION D-D

R.C. Pipe; size as shown on plans



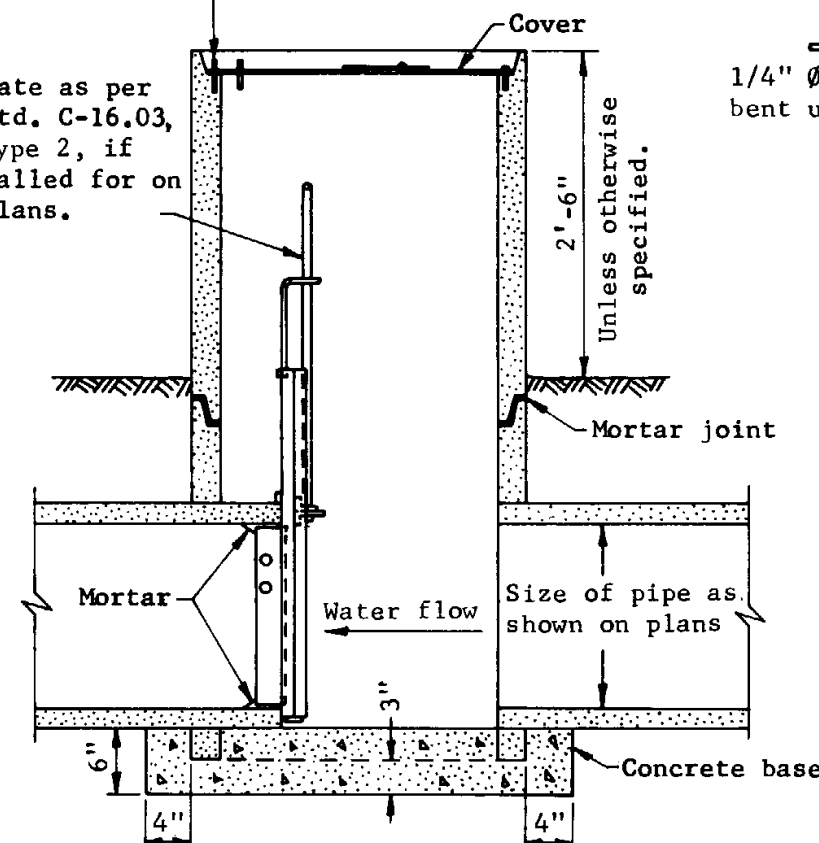
PLAN

Tee hinges, 1/4" steel, welded to cover all around with 1/4" fillet



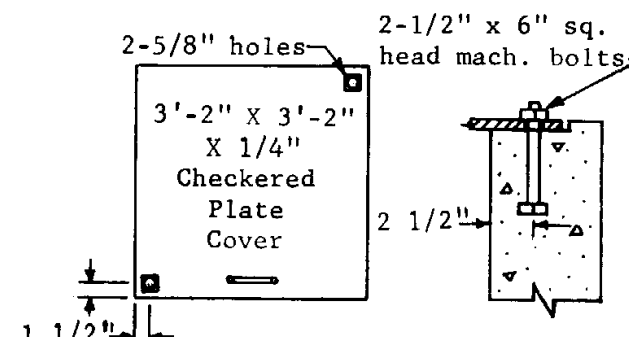
COVER FOR NO. 1 STANDPIPE

Gate as per Std. C-16.03, Type 2, if called for on plans.



SECTION A-A
IRRIGATION STANDPIPE NO. 1

GENERAL NOTES
All concrete shall be Class A.
Structural steel shall be in accordance with ASTM A 36.
All cover steel and exposed appurtenances shall be given one shop coat of No. 1 paint.
Plans shall specify locked or bolted cover for Standpipe No. 2



BOLTED COVER FOR
STANDPIPE NO. 2

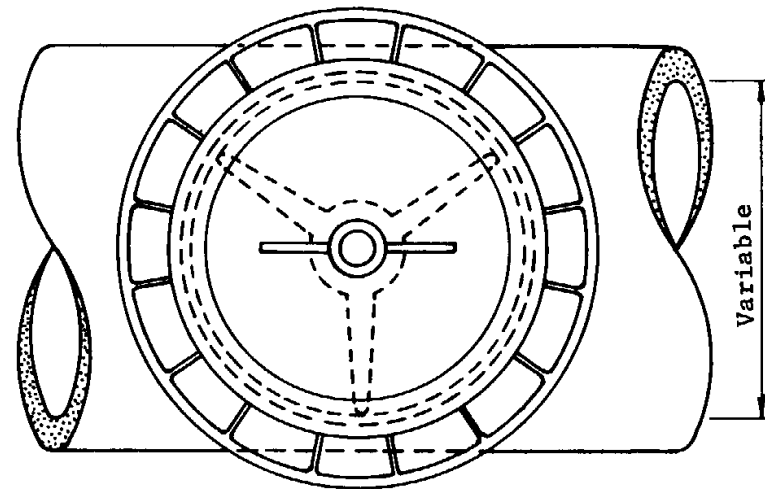
ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

IRRIGATION STANDPIPE NO. 1 AND NO. 2

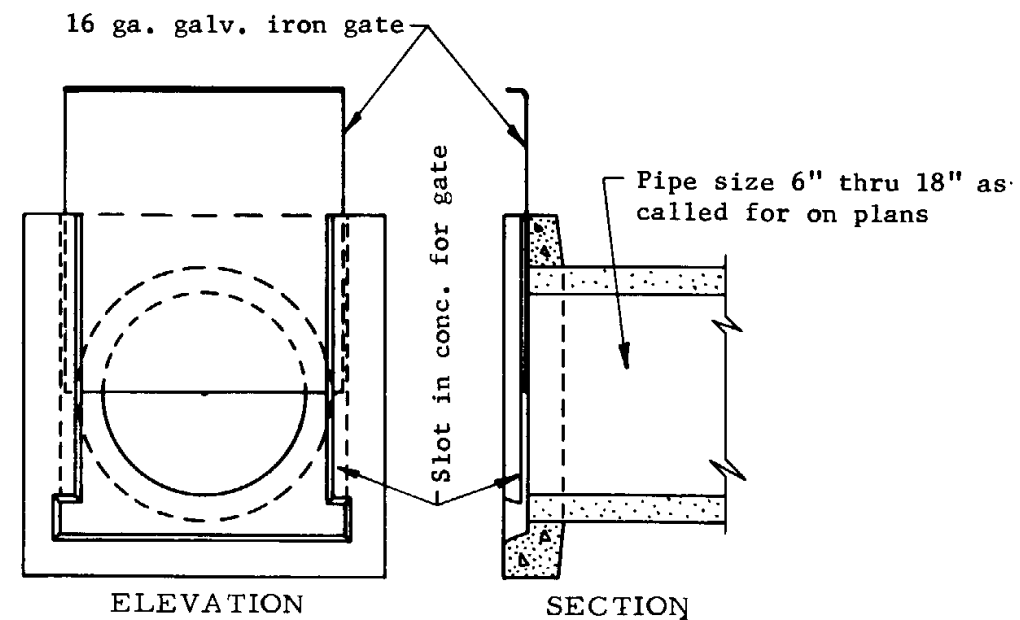
Drawn	D.G.
Traced	R.A.F. 10-67
Checked	J.P.O. 890 5-68
Approved	Eng. Plans 8/11/68

Drawing No.
C-16.02

Rev



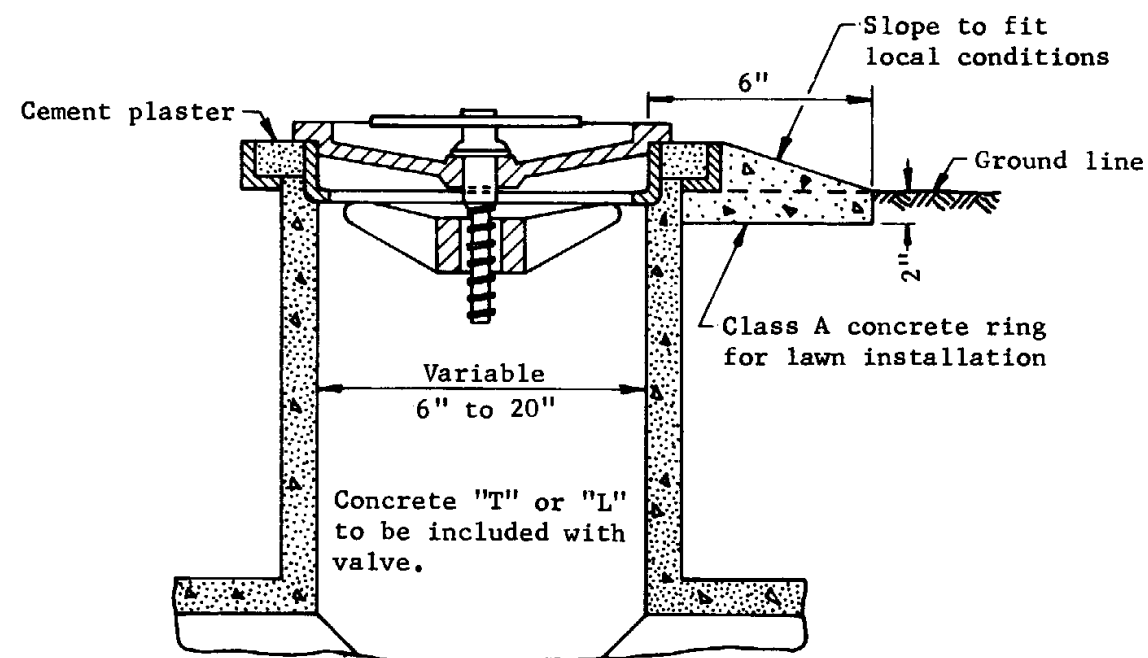
PLAN



ELEVATION

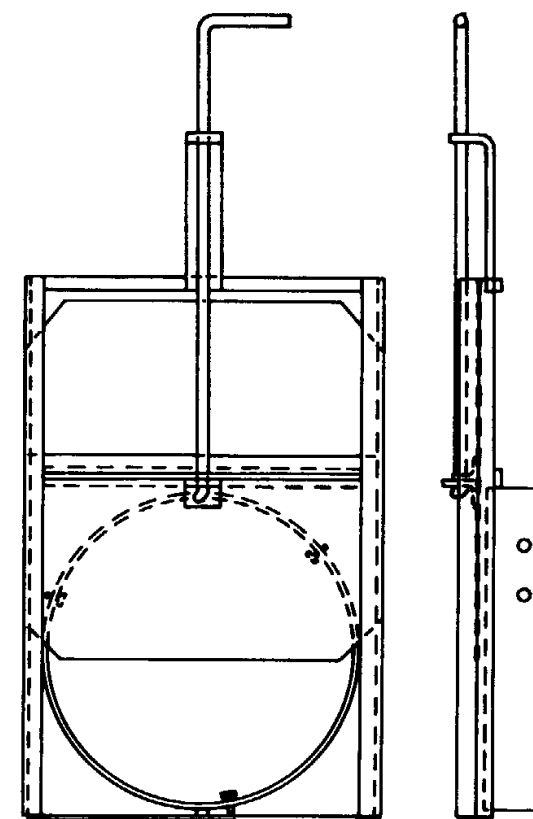
SECTION

PRECAST IRRIGATION GATE
For open ditch installation
TYPE 1



Irrigation Valve Number of valve shall correspond to the size of the pipe in inches. No. 6 to No. 20.

PART SECTION
FLUSH IRRIGATION VALVE,



ELEVATION

SECTION

IRRIGATION GATE
For standpipe installation
TYPE 2

TYPE 2

For pipes 6" through 24". Gate and frame shall be galvanized iron. Type shown is for concrete pipe. For C.M.P., external steel adjustable band shall be used in place of internal steel ring.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

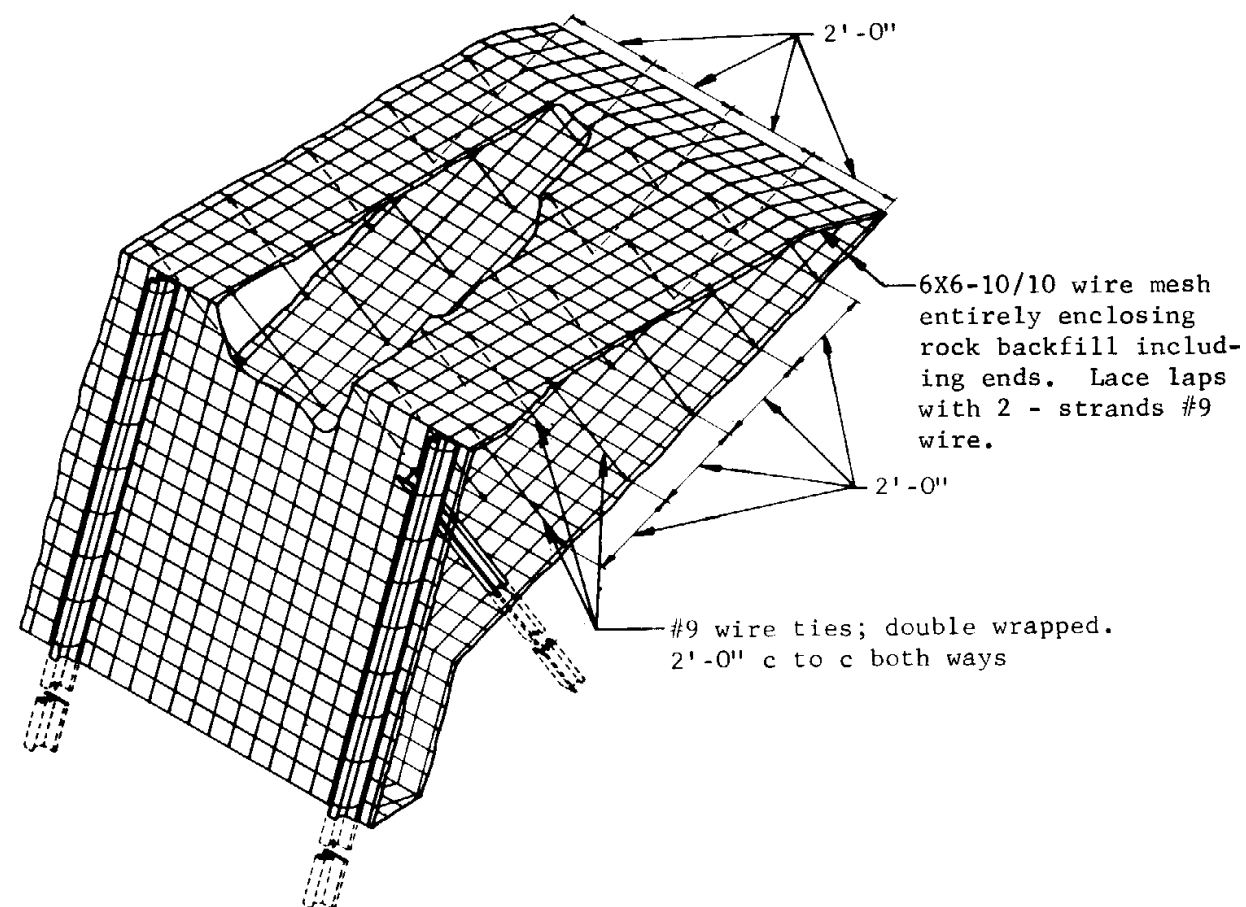
Rev

IRRIGATION VALVE IRRIGATION GATES

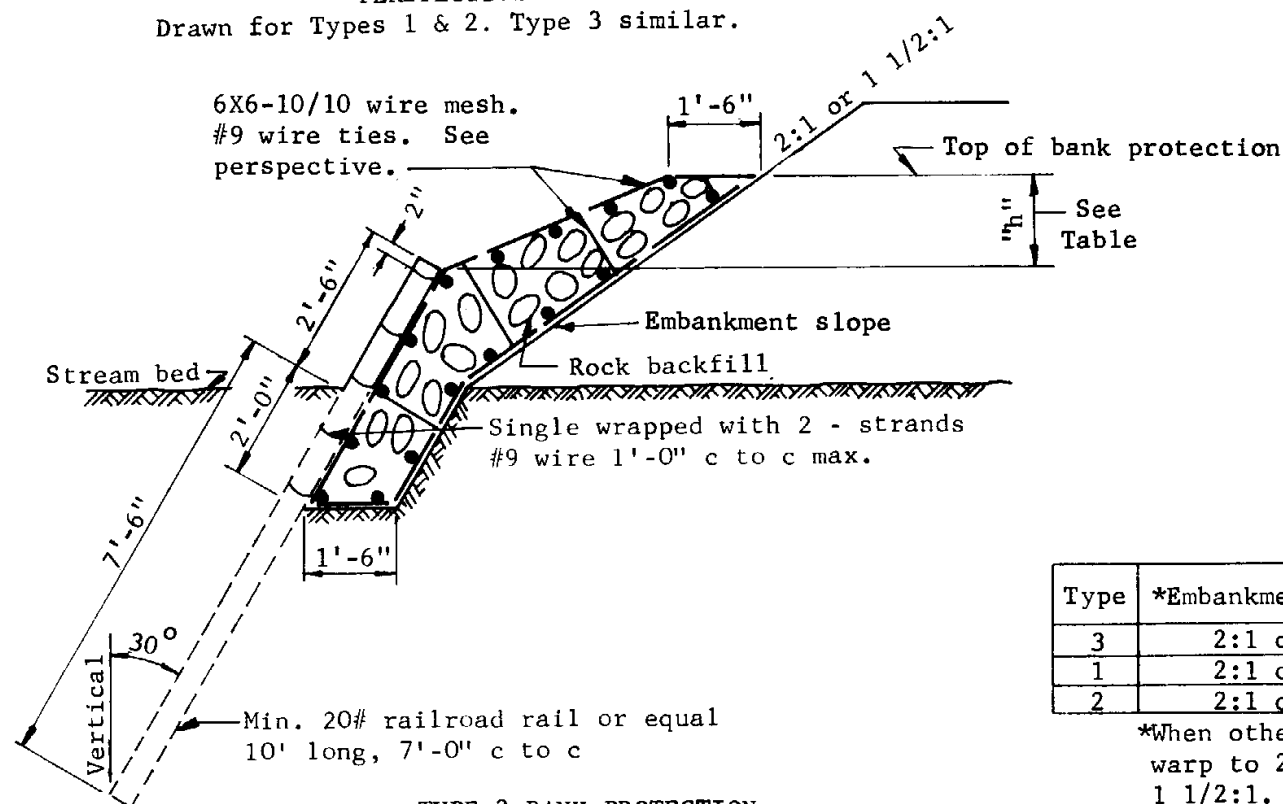
Drawn	O.K. 12/35
Traced	R.A.F. 10/66
Checked	J.P.O. 9/0 5-68
Approved	
Engr. Plans	W. H. H. 12-5-68

Drawing No.

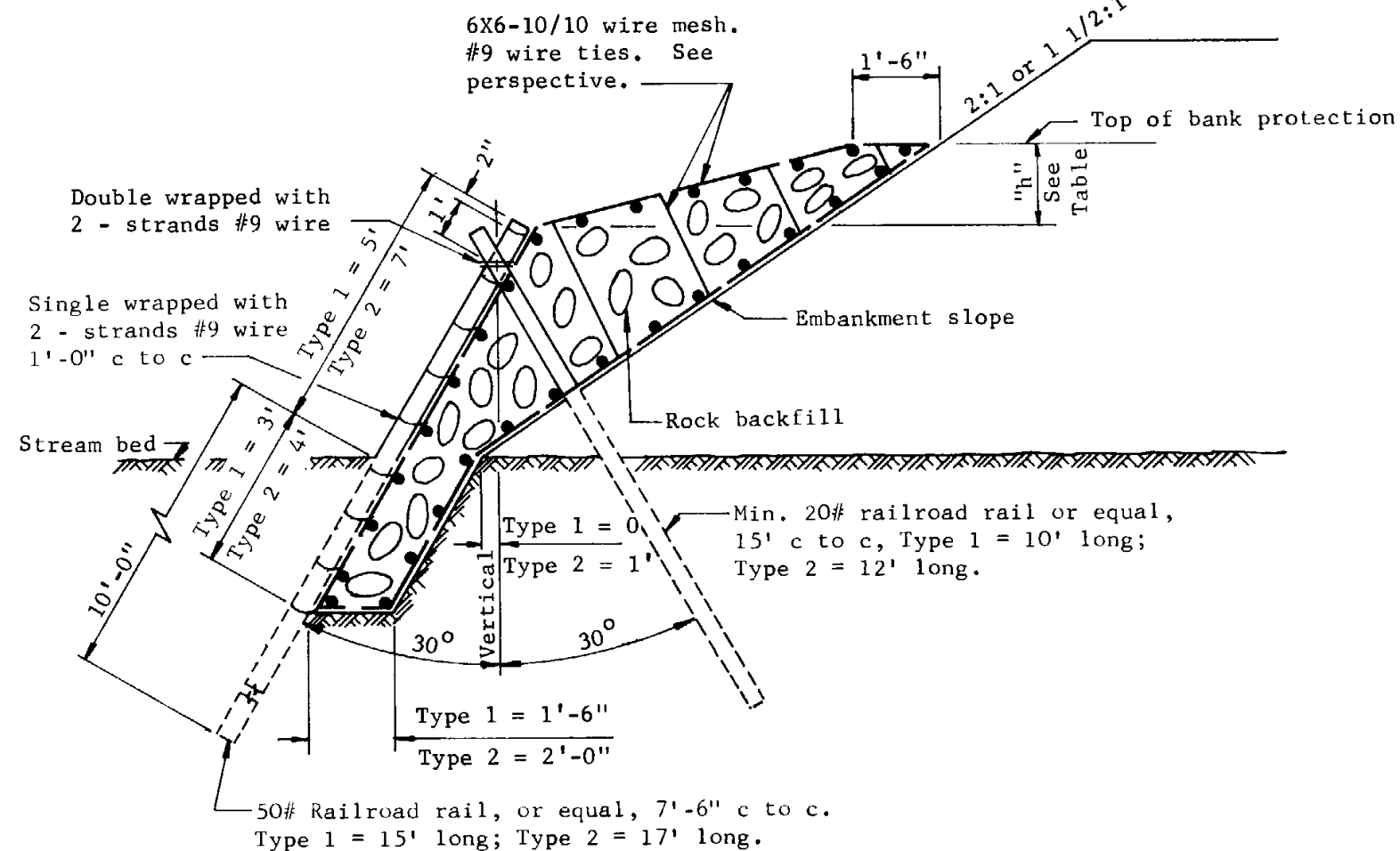
C-16.03



PERSPECTIVE
Drawn for Types 1 & 2. Type 3 similar.



TYPE 3 BANK PROTECTION



TYPE: TYPE 1 & 2 BANK PROTECTION

GENERAL NOTES
Rock for backfill shall not pass a 6" square opening.

Type	*Embankment slope rate	"h"	Top of bank protection above stream bed
3	2:1 or 1 1/2:1	0' to 2'	2' to 4'
1	2:1 or 1 1/2:1	0' to 3'	4' to 7'
2	2:1 or 1 1/2:1	0' to 6'	6' to 12'

*When other embankment slope rates are encountered, warp to 2:1 or 1 1/2:1; that is, warp 1:1 slope to 1 1/2:1.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
BANK PROTECTION TYPES 1, 2, & 3			
Drawn	H.A.K. 6-35	Drawing No.	
Traced	SLT & RAF 7-67		
Checked	J.P.O. 870-568		
Approved			
Engr. Plans	8/Heidecker 5-68		
			C-17.01

Thread cable through wire fabric and wrap one turn on each rail.

Wire fabric end piece

Type 4 = 4'
Type 5 = 5'

Mfgr's Std. Cable Clamp galvanized

Loop Cables around railroad rails as shown.

Rail heads face out

6 X 19 Galv. Plow Steel, preformed, fibercore cable 3/8" at top; 3/4" at bottom.

Rock backfill

PLAN

50# Railroad rail, 4' c to c
Type 4 = 15' long
Type 5 = 18' long

TYPES 4 & 5 BANK PROTECTION

6 X 6-10/10 Galv. wire fabric placed as shown to enclose all but the top surface of the rock backfill and attached to the rails by a single wrapping with 3 strands of #9 wire, 1'-0" c to c.

Type 4 = 4'
Type 5 = 5'

3/8" Dia. Cable

Rock backfill

Low stream bed

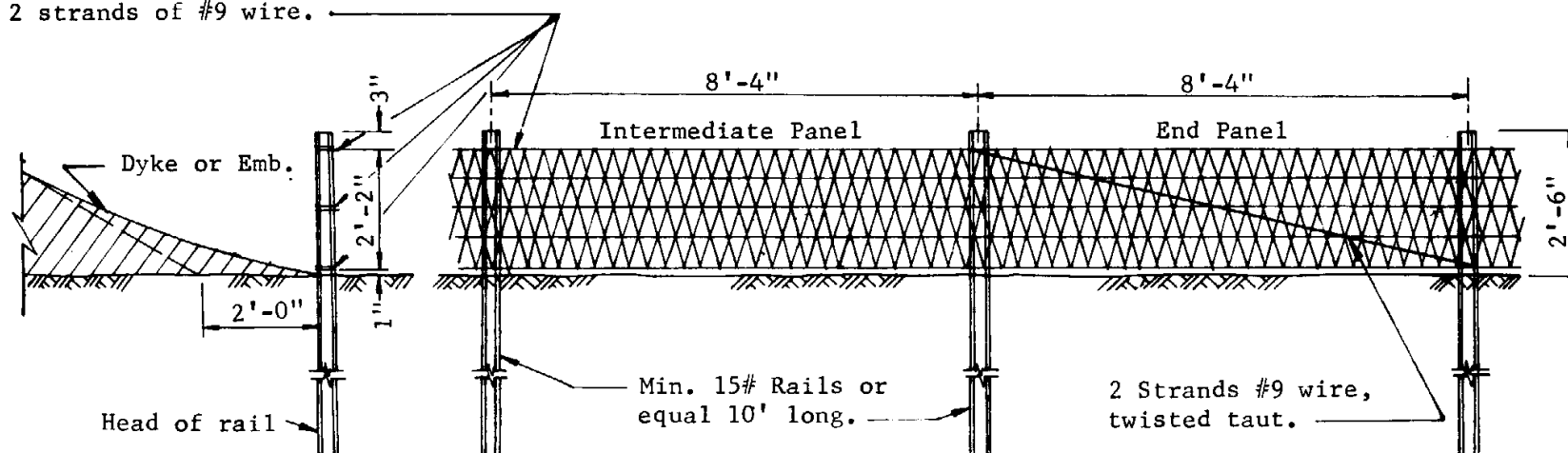
3/4" Dia. Cable

Type 4 = 4'
Type 5 = 7'

Type 4 = 2'
Type 5 = 3'

SECTION A-A

2" X 4" Δ galv. woven wire fabric; horizontal wires shall be 2 strands, twisted, min. 12 1/2 ga; diagonal wires min. 14 ga. Attach to rails as shown by single wrapping with 2 strands of #9 wire.



TYPE 6 BANK PROTECTION

GENERAL NOTES
Rock for backfill shall not pass a 6" square opening.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

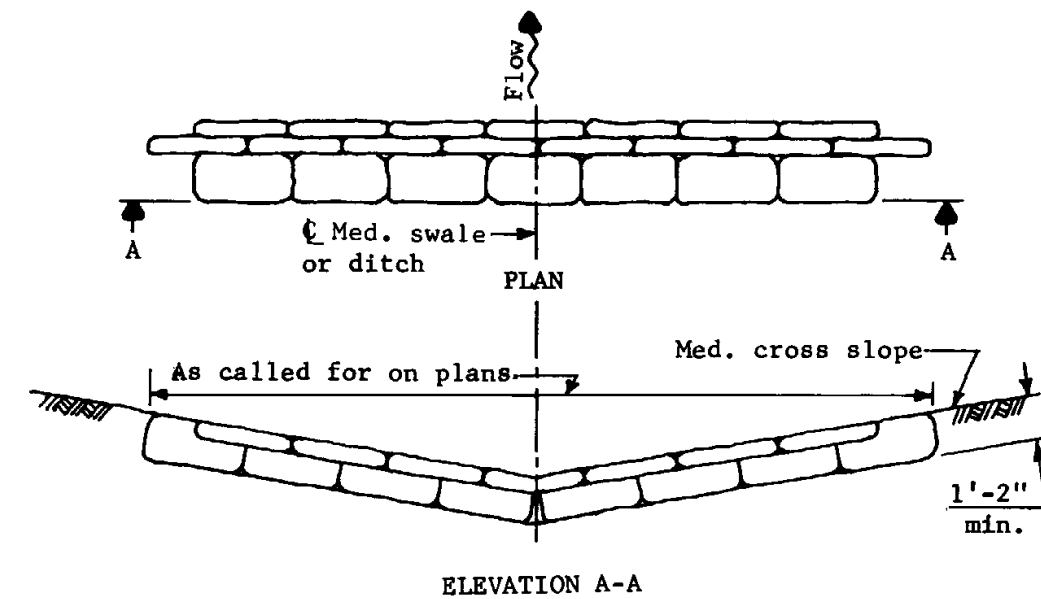
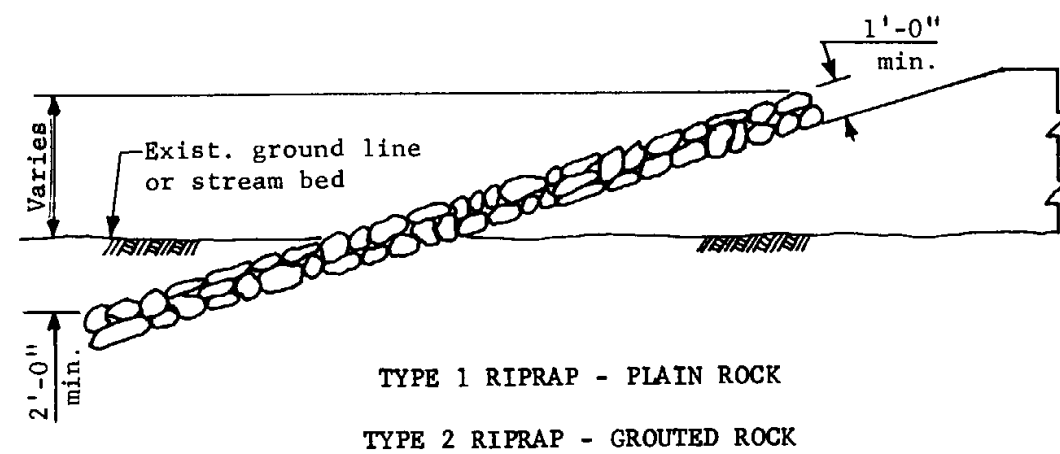
BANK PROTECTION
RAIL AND WIRE
TYPES 4, 5, & 6

Drawn	H.A.K. 6-35
Traced	S.L.T. 6-67
Checked	J.P.O. 8PO 5-68
Approved	
Engr. Plans	8Heinrich 5-68

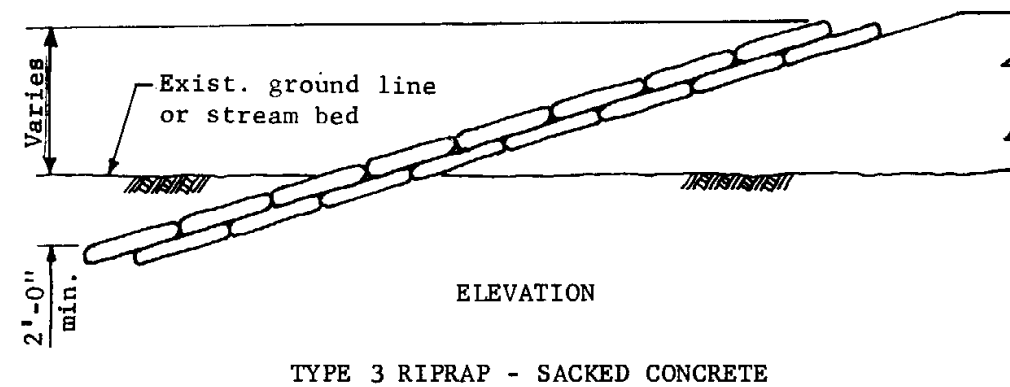
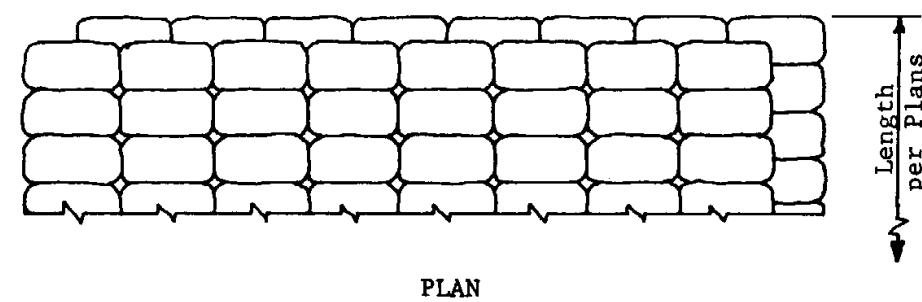
Drawing No.

C-17.02

Rev

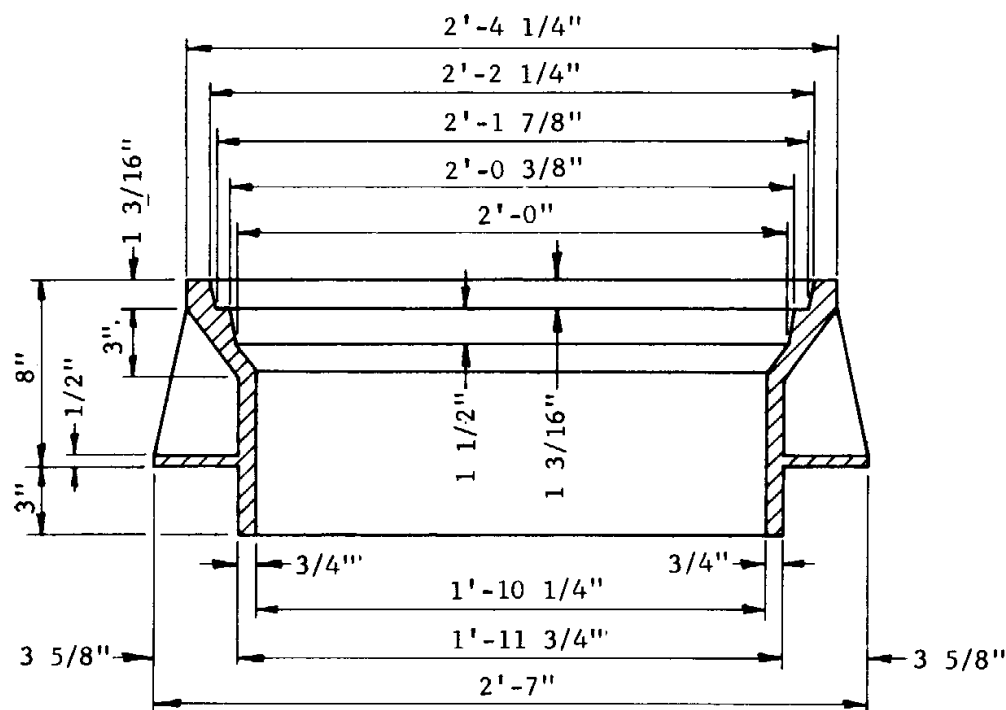
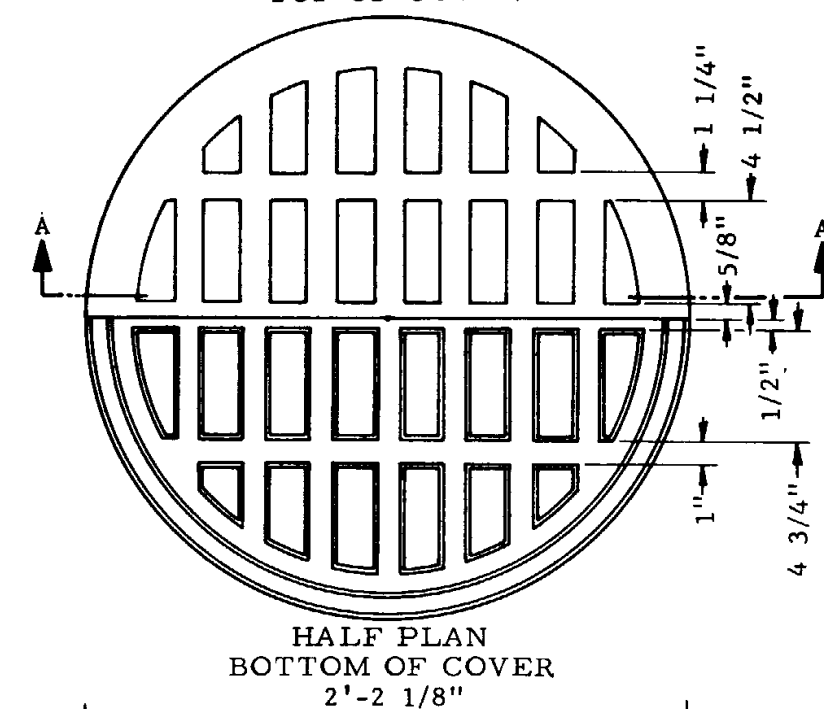
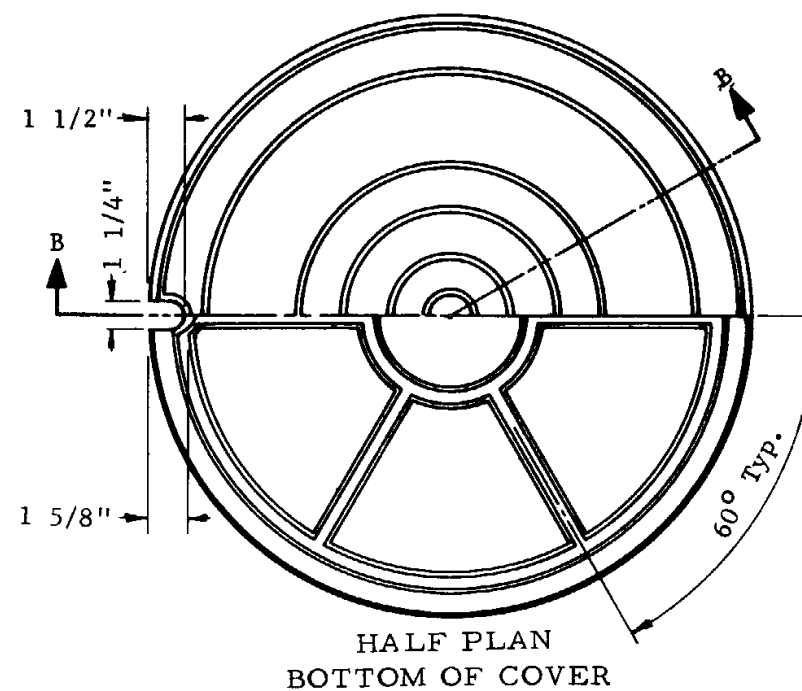
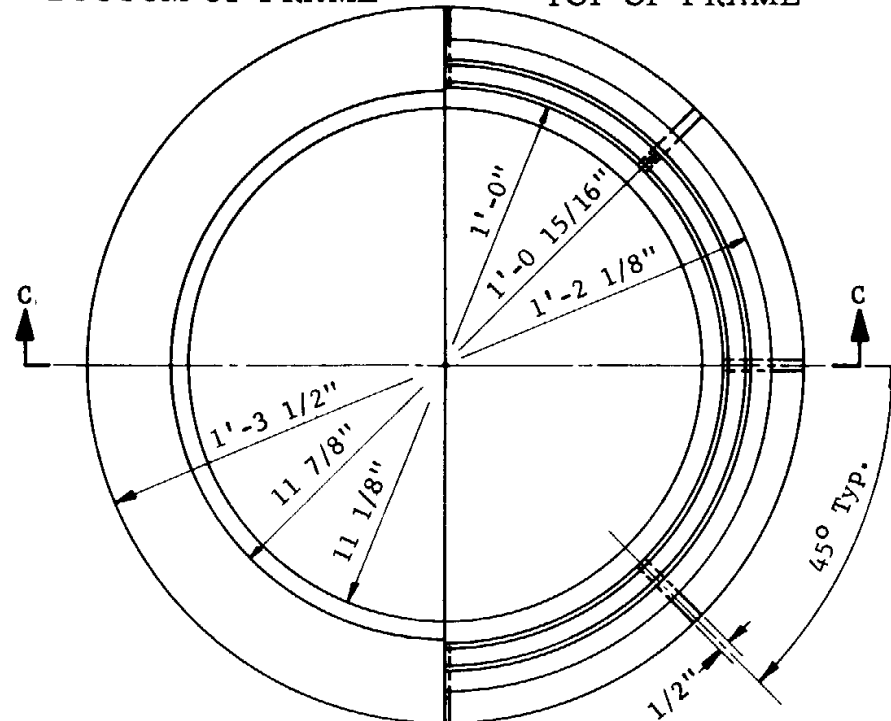
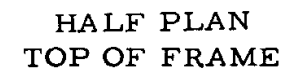


TYPE 4 RIPRAP - SACKED CONCRETE EROSION CHECK

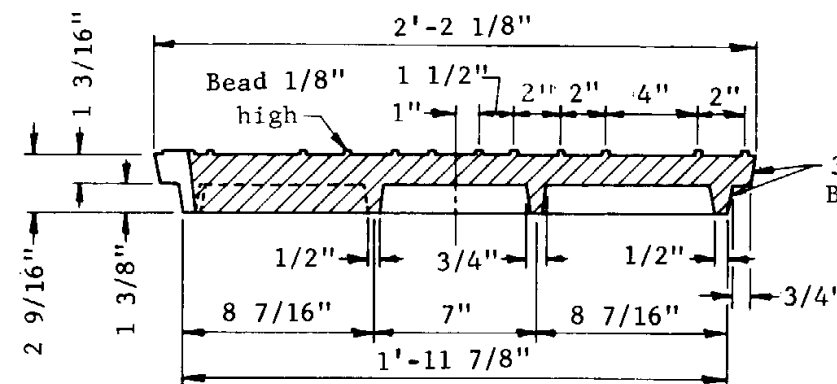


GENERAL NOTES
Grout for riprap may be pneumatically placed mortar.

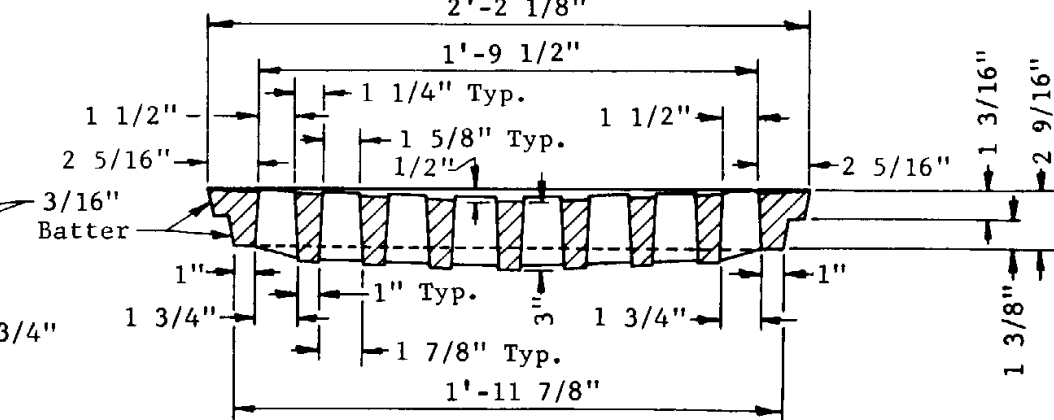
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
RIPRAP			
Drawn	D.G. 5-68	Drawing No. C-17.03	
Traced	D.G. 5-68		
Checked	J.P.O. <i>8/20 5-68</i>		
Approved Engr. Plans	<i>W. Heidrich 5-68</i>		



SECTION C-C OF FRAME
Approx. weight 260 lbs.



SECTION B-B OF COVER
TYPE A COVER
Approx. weight 190 lbs.



SECTION A-A OF COVER
TYPE B COVER
Approx. weight 280 lbs.

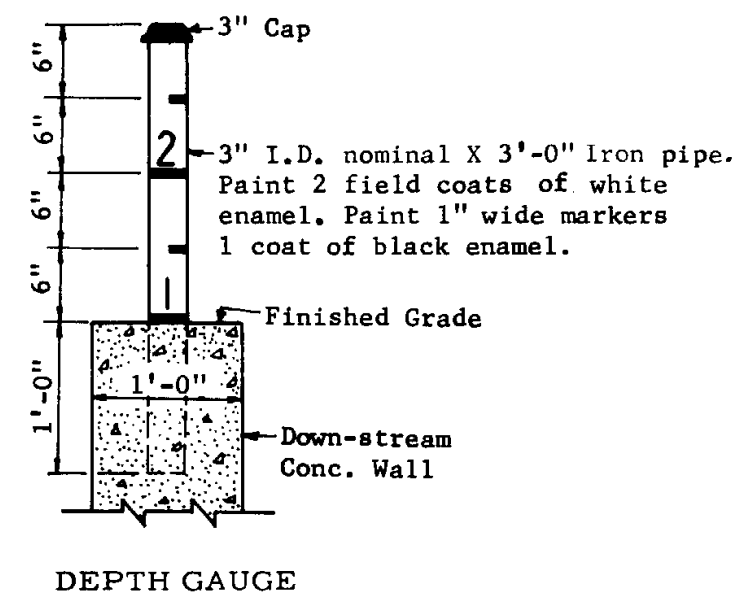
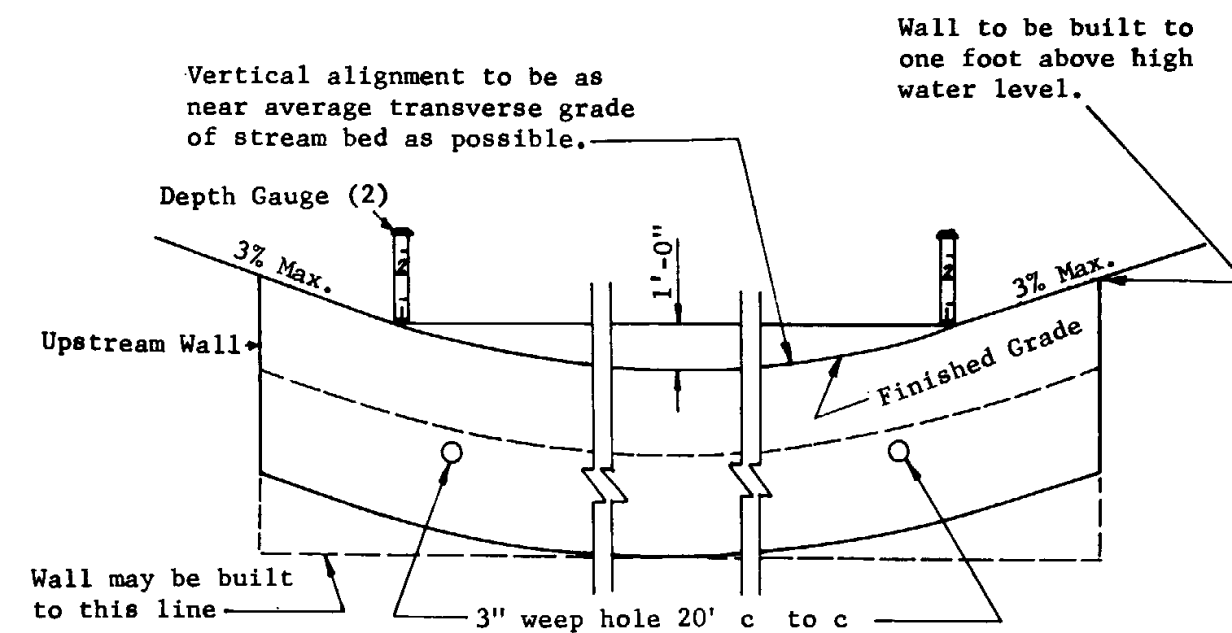
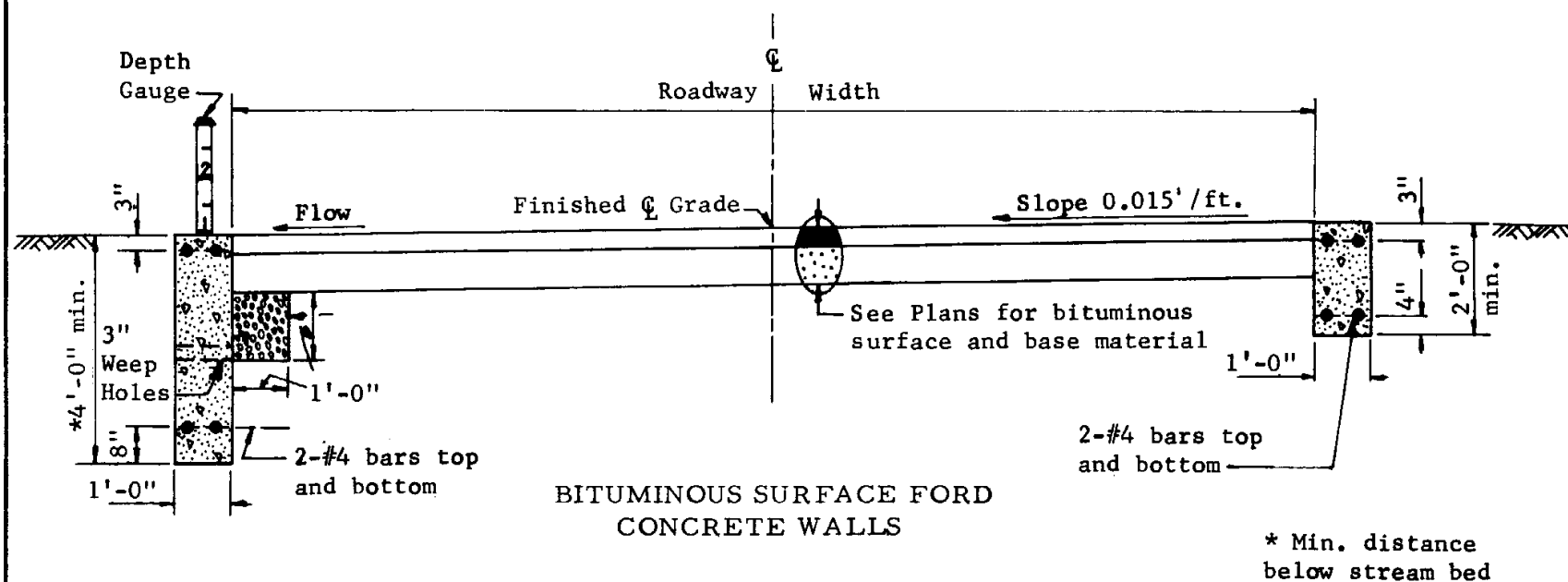
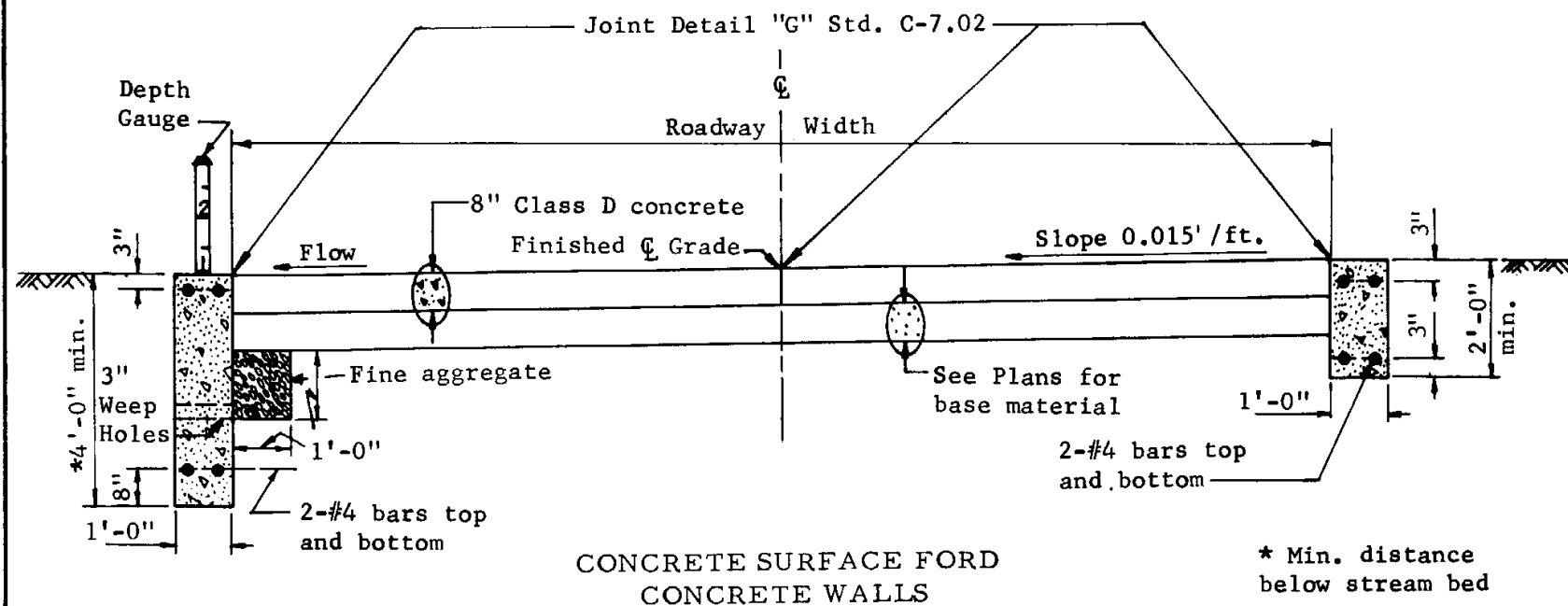
GENERAL NOTES

Type C cover shall be the same as Type A except that the cover shall be vented with at least six one inch holes, equally spaced in a circle 8 1/2" from the center of the cover.

Type A cover shall be used unless otherwise specified.

The bearing faces shall be machined so that the cover will have a uniform bearing in any position in the frame.

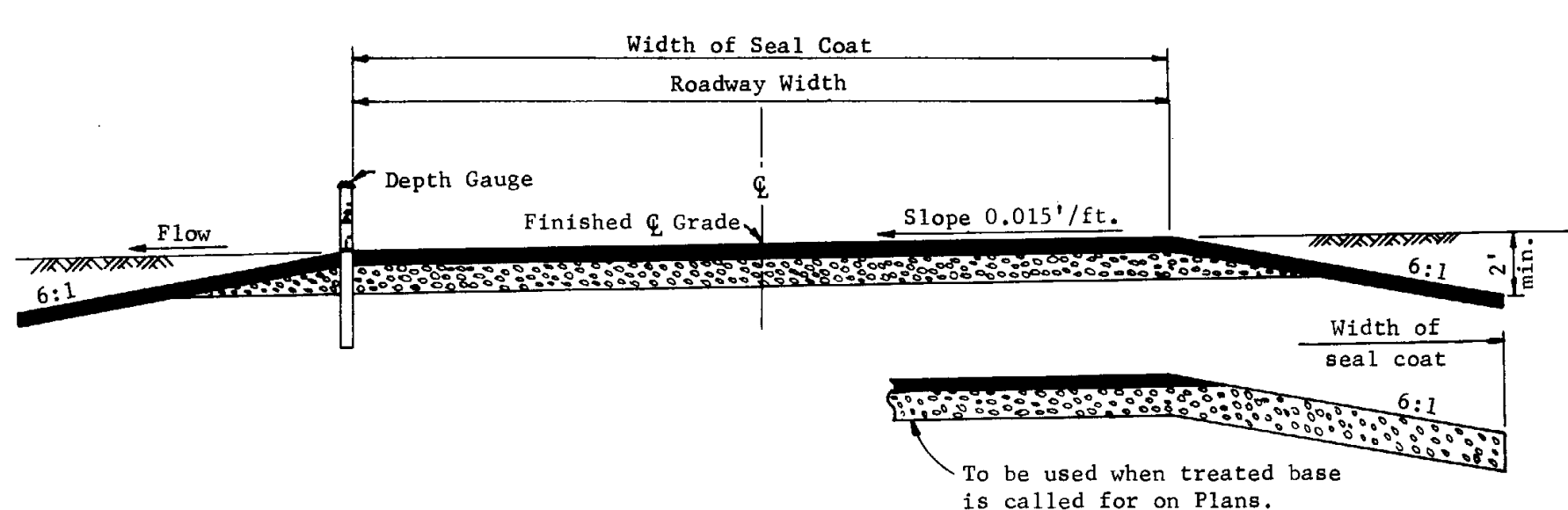
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
MANHOLE-CAST IRON FRAME & COVER DETAILS		
Drawn	O.K. 10-35	Drawing No. C-18.02
Traced	R.A.F. 6-67	
Checked	J.P.O. <i>JP 5-68</i>	
Approved Engr. Plans	<i>W. Heider</i> 5-68	



GENERAL NOTES

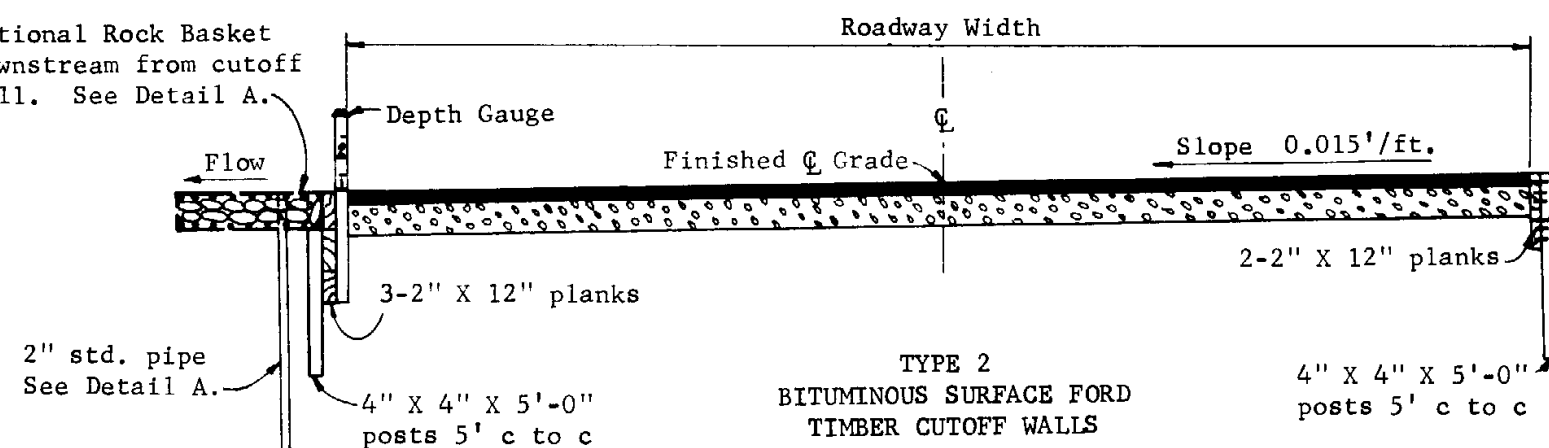
Ford walls to be
Class D Concrete.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
<div style="text-align: center;"> <h1>FORD</h1> <h1>CONCRETE WALLS</h1> </div>		
Drawn	C.B.B. - 7-45	Drawing No.
Traced	S.L.T. - 5-67	
Checked	J.P.O. 9-0 5-68	
Approved Engr. Plans	<i>W. H. ... 5-68</i>	
		C-19.01

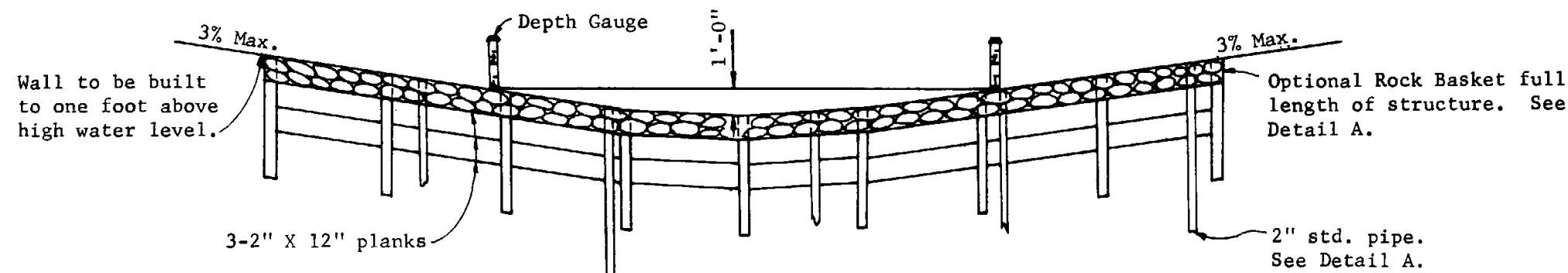


TYPE 1
BITUMINOUS SURFACE FORD

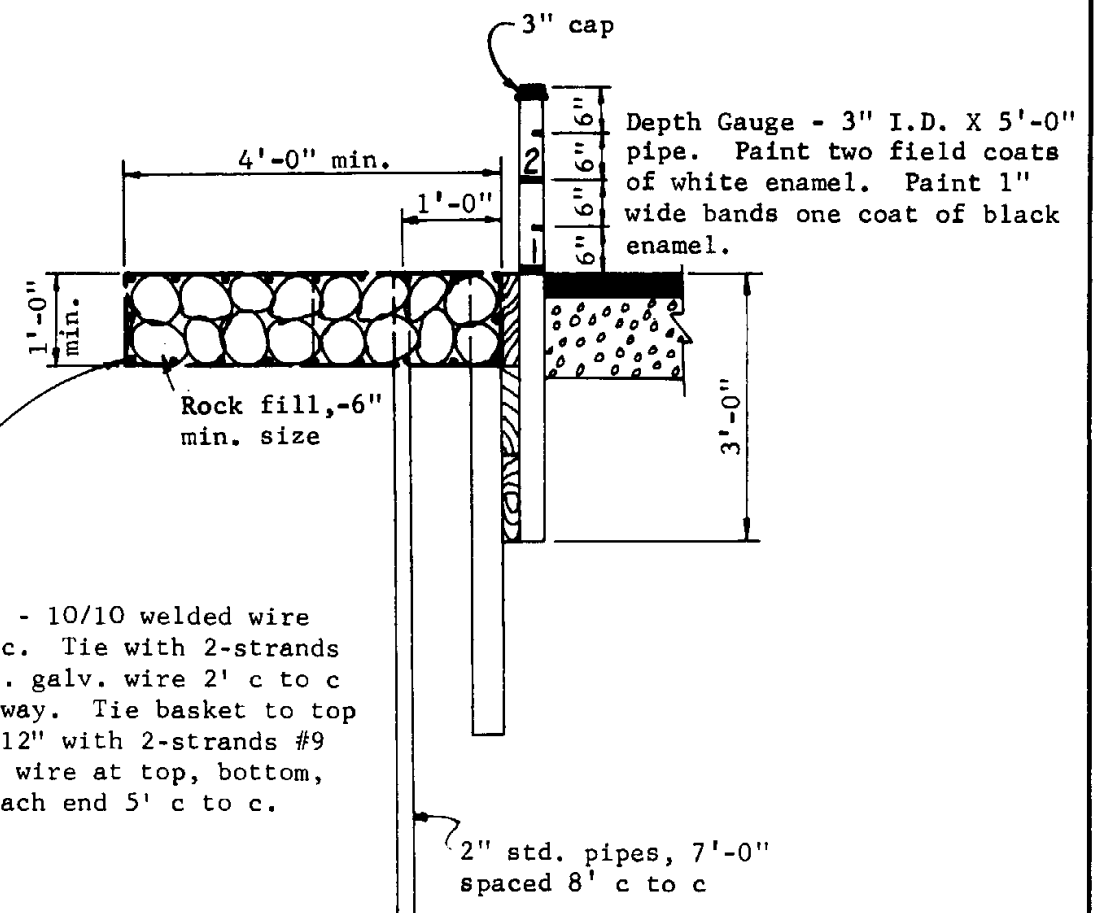
Optional Rock Basket
downstream from cutoff
wall. See Detail A.



TYPE 2
BITUMINOUS SURFACE FORD
TIMBER CUTOFF WALLS



ELEVATION - TYPE 2

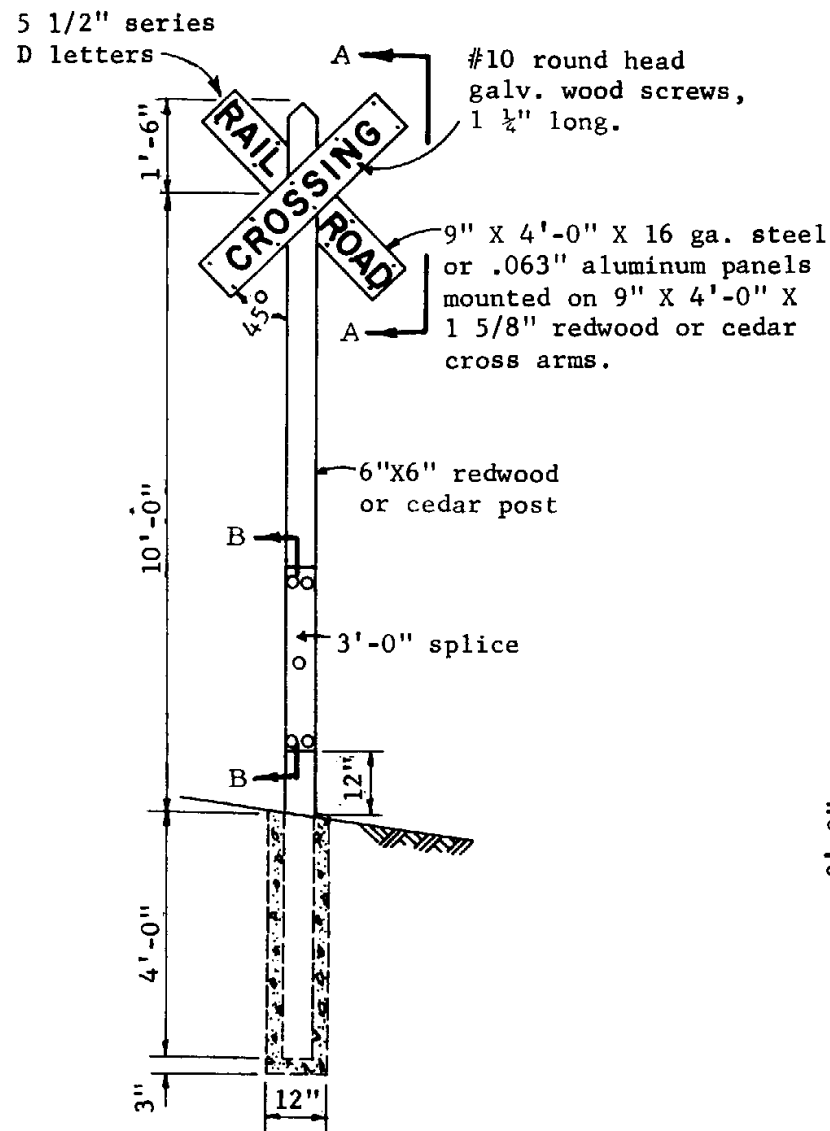


DETAIL A

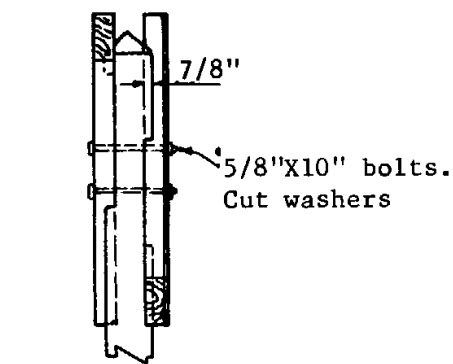
GENERAL NOTES

- All timber shall be rough, pressure treated and unpainted.
- Rock basket, full length of structure shall be included only when called for on Plans.
- See Plans for bituminous surface and base material details.
- Galvanize pipes in accordance with ASTM A123.

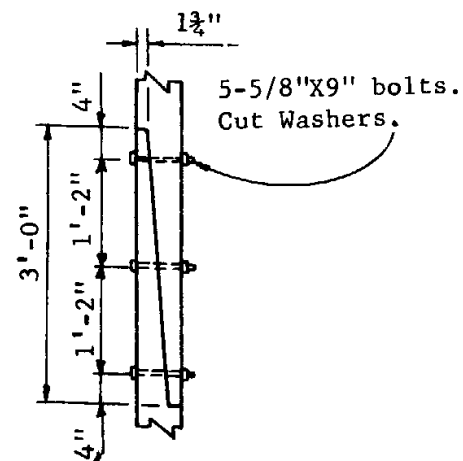
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
FORDS			
Drawn	C.B.B. 7-45	Drawing No. C-19.02	
Traced	S.L.T. 5-67		
Checked	J.P.O. 8-68		
Approved Engr. Plans	W. H. H. 5-68		



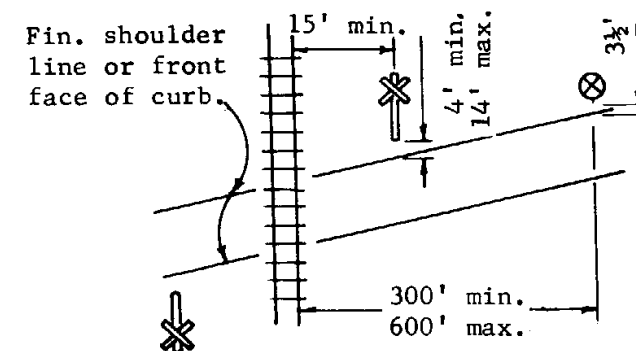
RAILROAD CROSSING SIGN



SECTION A-A

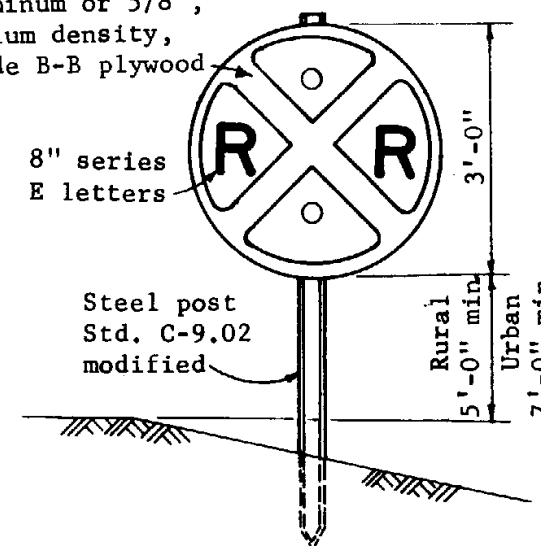


SECTION B-B



LOCATION PLAN

.063", 6061T6 aluminum or 5/8", medium density, grade B-B plywood



RAILROAD ADVANCE WARNING SIGN

GENERAL NOTES

All wood shall be redwood or cedar, S4S and untreated.

When a single railroad crossing sign is used for a crossing, both sides of cross arms shall carry sheet steel or aluminum message panels. When two railroad crossing signs are used for a crossing, lettered message panels shall be mounted only on the side of cross arms facing traffic.

Railroad Crossing Sign message panel background shall be silver-white flat top reflective sheeting with black, opaque letters.

Advance Warning Sign traffic face background shall be highway yellow flat top reflective sheeting with black, opaque letters, border and symbol.

All wood and metal surfaces, except those covered with reflective sheeting shall be primed and finished with two coats of No. 11 white enamel.

Reflective sheeting shall be applied in accordance with the manufacturer's specifications.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

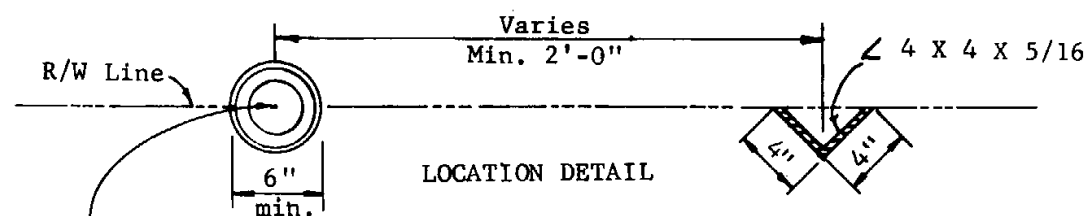
RAILROAD CROSSING SIGNS

Drawn	D.G.	12-66
Traced	S.L.T.	3-67
Checked	J.P.O.	8PO 5-68
Approved	Weidenbach 5-68	
Engr. Plans		

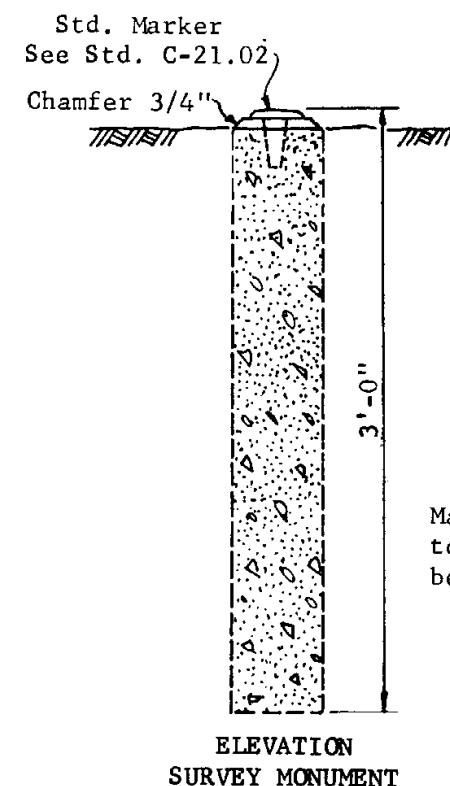
Drawing No.

C-20.01

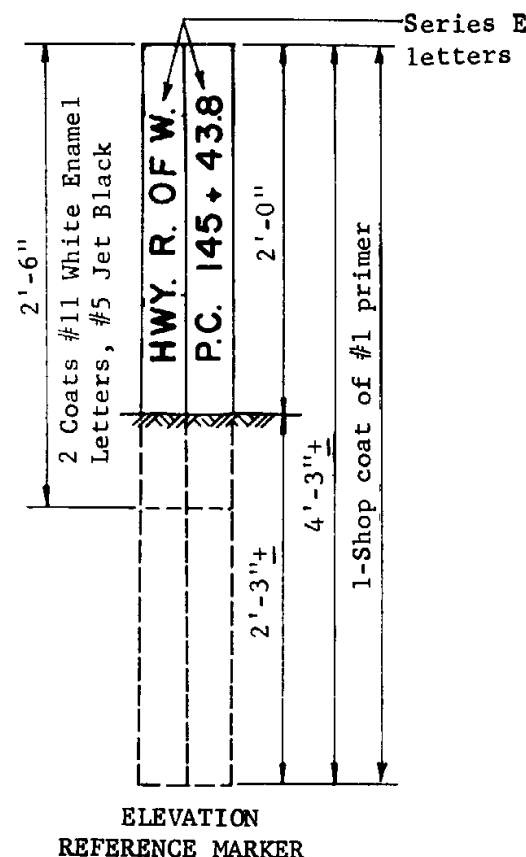
Rev



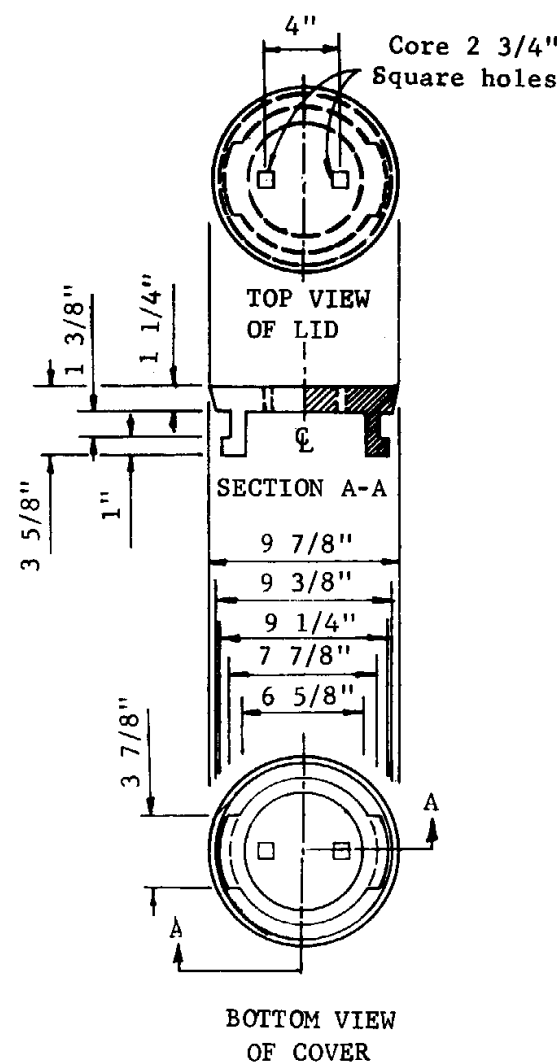
Std. Marker. Transit point shall be punched by Engineer.



May be poured to neat lines below grade.

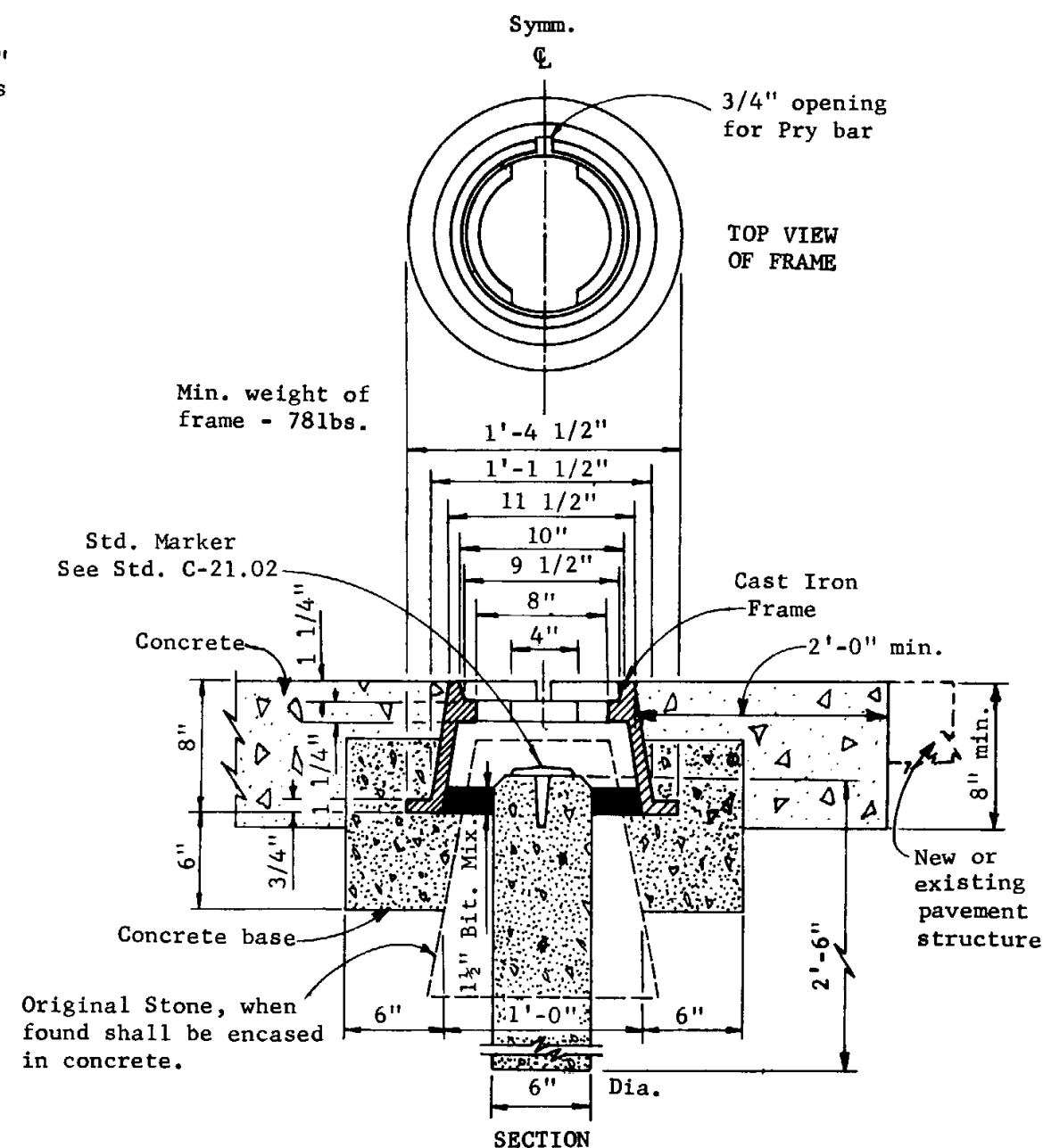


RIGHT OF WAY MARKER



Min. weight of cover - 31 lbs.

SURVEY MONUMENT, FRAME AND COVER



Original Stone, when found shall be encased in concrete.

GENERAL NOTES

A Survey Monument, Frame and Cover, complete and in place, shall be considered as a unit. In bituminous pavement, frame and cover shall be set after A. C. is placed.

A Right of Way Marker, consisting of Survey Monument and Reference Marker, complete and in place, shall be considered as a unit. Right of Way Markers shall be placed as shown on Plans or as directed by the Engineer.

All concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

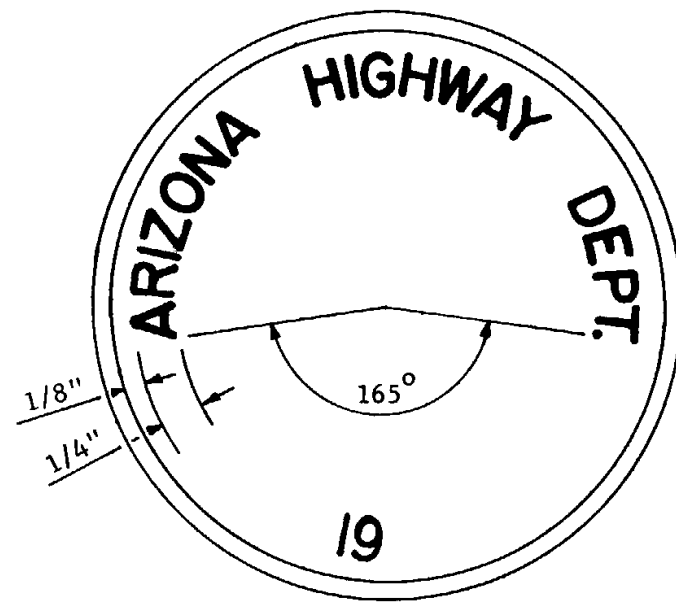
SURVEY MONUMENT, FRAME AND COVER RIGHT OF WAY MARKER

Drawn	11-45
Traced	S.L.T. 3-67
Checked	J.P.O. 8PD 5-68
Approved	
Engr. Plans	8/11/68

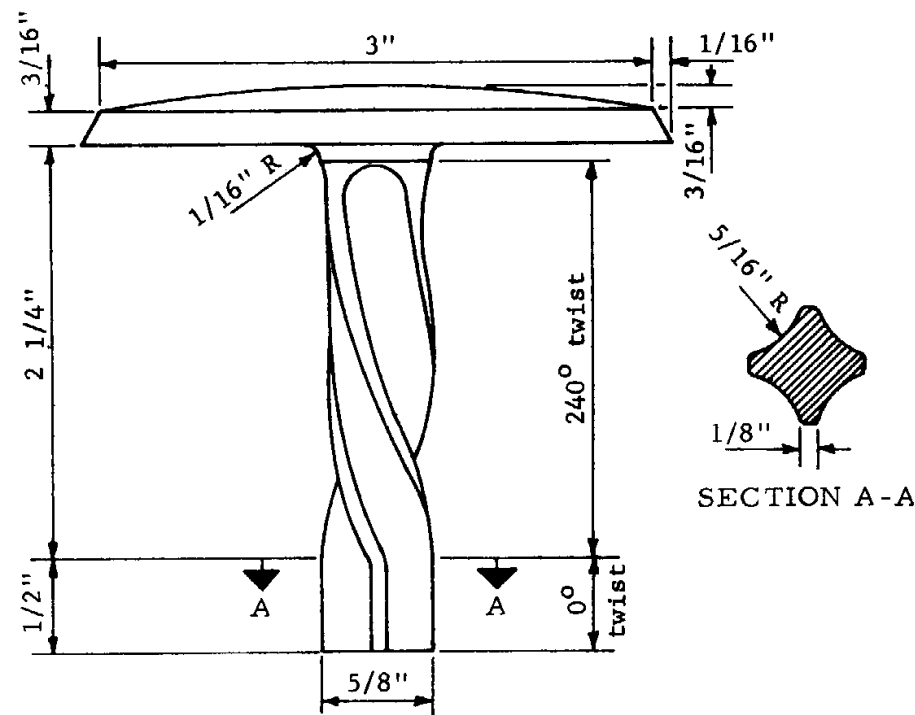
Drawing No.

C-21.01

Rev



PLAN



ELEVATION

STANDARD MARKER
FOR USE AS BENCH, SURVEY
MONUMENT AND R/W MARKERS

GENERAL NOTES

Standard Marker shall be made of
brass or bronze.

Standard Marker shall be furnished
by the State.

Bench marks will be established, by
the Engineer, on headwalls, bridge curbs
or other permanent structures.

ARIZONA HIGHWAY DEPARTMENT
PLANS DIVISION

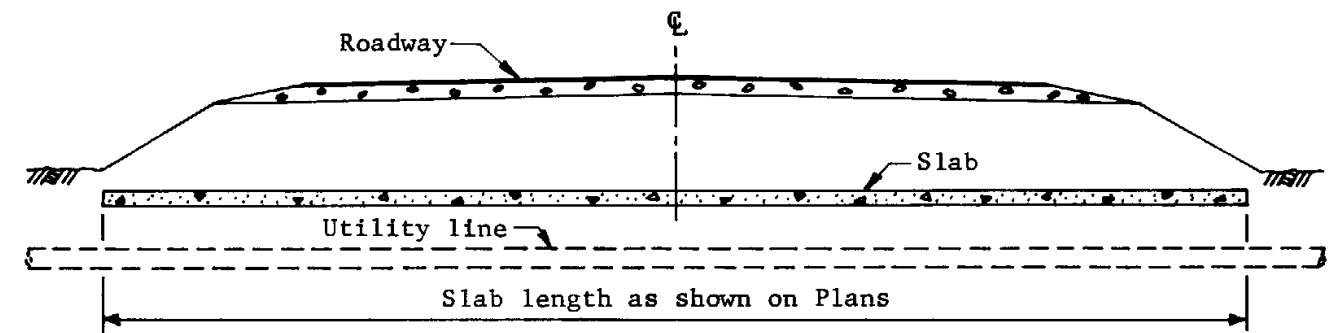
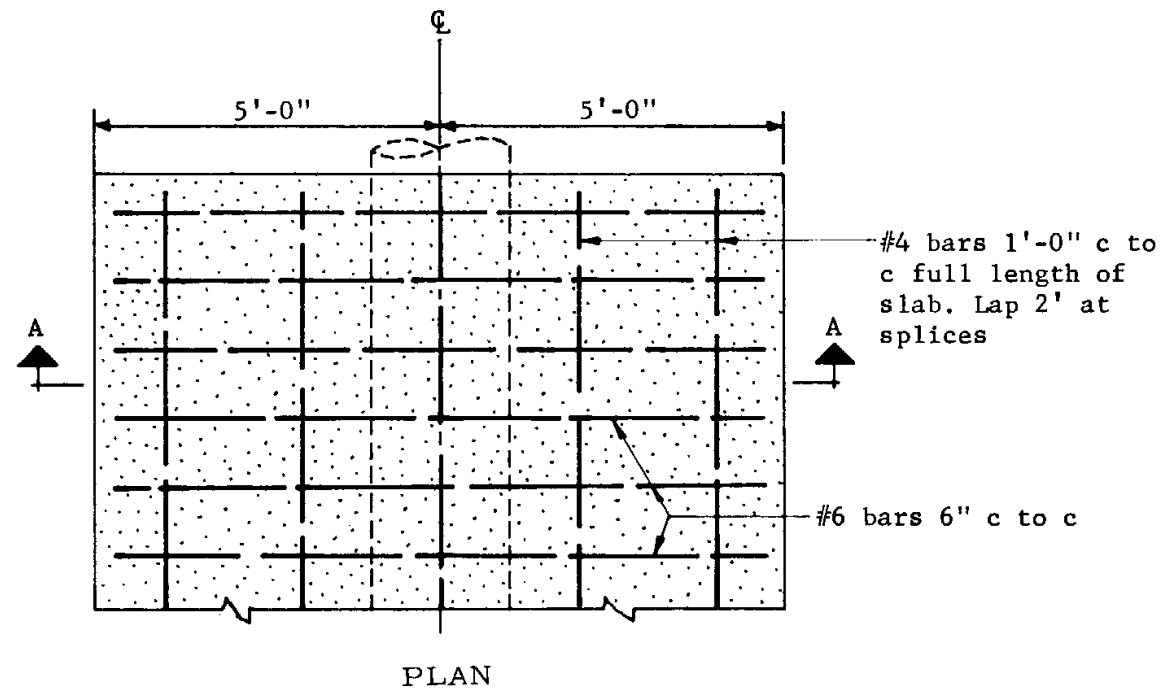
STANDARD MARKER

Drawn	D.G. 2-68
Traced	D.G. 2-68
Checked	J.P.O. 9/10 5-68
Approved Engr. Plans	<i>H. Heidecker</i> 5-68

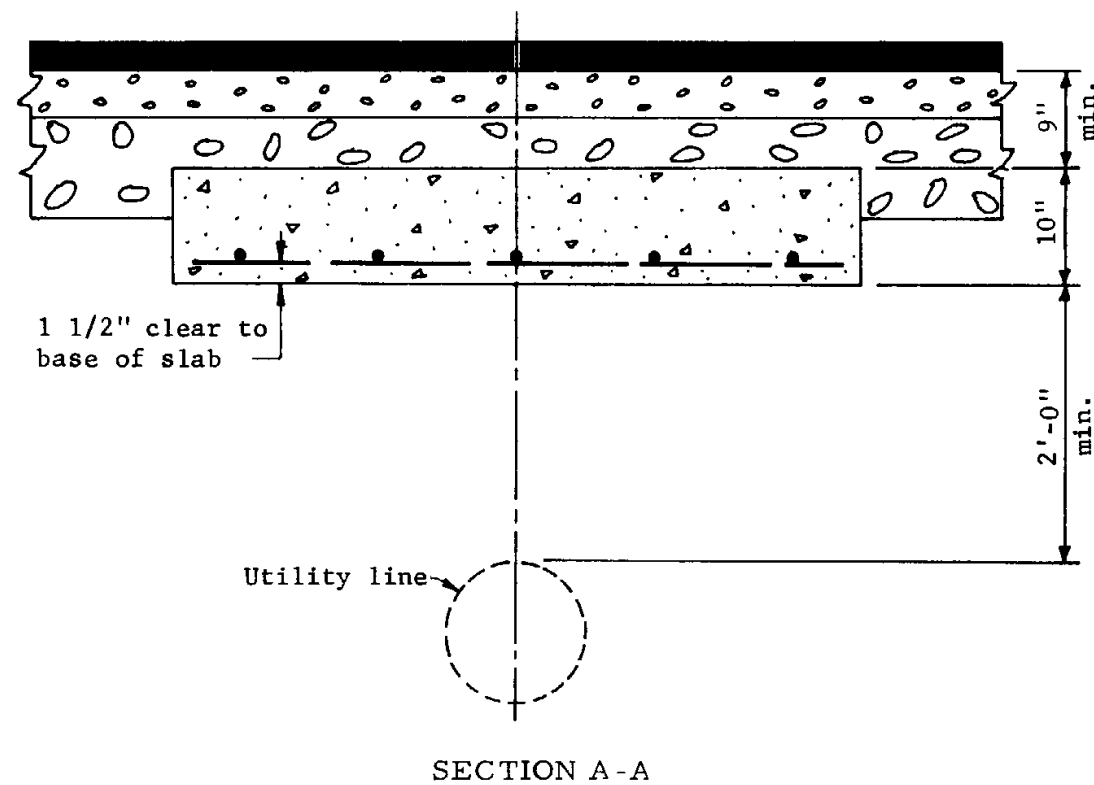
Drawing No.

C-21.02

Rev



FOR SINGLE INSTALLATION	
Quantities per ft. of slab length	
Concrete	Reinforcing Steel
0.31 C.Y.	35.22 lbs.



GENERAL NOTES
Concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
SLAB OVER UTILITY LINE			
Drawn	L.O.M. 5-65	Drawing No. C-22.01	
Traced	D.G. 3-67		
Checked	J.P.O. 8/10 5-68		
Approved Engr. Plans	<i>J. Heidrich</i> 5-68		

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